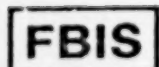


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26 October 1984

# USSR Report

SPACE



FOREIGN BROADCAST INFORMATION SERVICE

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26 October 1984

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## MANNED MISSION HIGHLIGHTS

### FEATURES AND USES OF 'PROGRESS' CARGO SHIPS

Ashkhabad TURKMENSKAYA ISKRA in Russian 19 Jun 84 p 3

[Article by M. Chernyshov, correspondent]

[Abstract] The article provides general information on the role and capabilities of automatic cargo spaceships of the "Progress" series.

The "Progress" ship is said to be essentially a "Soyuz" spacecraft with all of its manned-flight equipment removed and automatic control systems added. The "Progress" has a launching mass of 7 tons and can take a payload of 2.3 tons on board. The type of cargo it carries can be changed to meet current requirements. Some ships have transported chiefly items that are subject to depletion, such as fuel, water, foodstuffs, and air regenerators for the space station's life-support systems; other ships have carried cargo consisting mostly of instruments and equipment. An improvement in the most recent "Progress" spaceships is a system for pumping liquids automatically from the ship into the station, which practically eliminates the participation of the station's crew in this operation. Each "Progress" usually has some fuel left in its own propulsion system after docking with the orbiting station, and this fuel can be used to boost the station's orbit.

It is recalled that 12 "Progress" ships supplied the "Salyut-6" station during the time it was in orbit from 1977 to 1982. The overall weight of the cargo delivered by these spaceships was greater than the station's own launching weight (about 20 tons). The overall weight of the cargo delivered by "Progress" ships to the "Salyut-7" station also is said to exceed the station's own weight. In addition to bringing the crew needed supplies, "Progress" ships take away use-up items which accumulate during missions.

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## FEATURES OF NEW SOLAR PANELS ON 'SALYUT-7'

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 20 May 84 p 4

[Article by G. Lomanov, special correspondent at the Flight Center]

[Abstract] The article records comments of specialists at the Flight Control Center during the EVA of cosmonauts Kizim and Solov'yev to install extra panels on a solar battery of the orbiting station "Salyut-7".

Doctor of Technical Sciences Konstantin Petrovich Feoktistov compared the operation with the first such EVA on the station's batteries, which was performed by cosmonauts Vladimir Lyakhov and Aleksandr Aleksandrov in November of 1983. Whereas Lyakhov and Aleksandrov installed one extra panel during each of two separate egresses, Kizim and Solov'yev installed two panels at one time. These panels are made of gallium arsenide. Each battery made of this material provides a maximum charge current of 20 amperes, which is 6 amperes more than that of a silicon battery. The panels are folded like an accordion prior to installation. They are installed with the aid of a cable on a winch. The cable is attached to the top part of the panel, and the panel is opened up by turning the winch. The extra panels reportedly have increased the area of the station's solar batteries by more than 9 square meters.

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#### ADDITIONAL DETAILS ON SOLAR PANEL INSTALLATION

Moscow TRUD in Russian 20 May 84 p 3

[Article by I. Melenevskiy, special correspondent at the Flight Control Center]

[Abstract] The article gives excerpts of communications between the Flight Control Center and cosmonauts Leonid Kizim and Vladimir Solov'yev outside the orbiting station "Salyut-7" during their work to install extra solar panels.

Asked whether they encountered any problems, Solov'yev reported that a handle of their winch had broken. It is noted that after the operation was completed, the cosmonauts disposed of the panels' containers by throwing them aside into space. Care had to be taken to cast the containers into a different orbit, to prevent the station from encountering them in the future. Whereas the enlargement of solar batteries on a previous mission added about 800 watts to the station's power, the operation carried out by Kizim and Solov'yev reportedly has increased the power by approximately 1,200 watts.

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# TASS REPORTS DESTRUCTIVE REENTRY OF 'PROGRESS-21'

Moscow KRASNAYA ZVEZDA in Russian 27 May 84 p 1

[TASS Report]

[Text] Flight Control Center, May 26. The flight of the automatic cargo ship "Progress-21", which went into near-Earth orbit on May 8, 1984, has ended.

The ship docked with the "Salyut-7" station on May 10. All scheduled operations were completed in their entirety: unloading, refueling of the combined engine assembly, and pumping of water into the station's tanks. Two corrections of the orbit of the manned complex were executed with the aid of the cargo ship's engine.

Today at 1:41 p.m., Moscow time, the "Progress-21" ship was undocked from the "Salyut-7" station. Its engine was fired at the calculated time. Following braking, the cargo ship went into a descending trajectory, entered the dense layers of the atmosphere and ceased to exist.

Leonid Kizim, Vladimir Solov'yev and Oleg At'kov are continuing to carry out the planned program of work on the "Salyut-7" station.

In the week just past, the cosmonauts conducted a number of technical experiments and medical studies.

The purpose of an experiment called "Torsion" was to make further studies of the effects of open space on structural materials. Changes in physical-mechanical characteristics of material were determined by means of evaluating parameters of free damped vibrations that were periodically transmitted to the specimens being examined. This experiment was conducted using an instrument installed in an airlock chamber of the station.

The medical part of the program included an examination of the cardiovascular system using the method of echography, and also an evaluation of the condition of the visual apparatus.



According to medical monitoring data and the crew's reports, the cosmonauts are in good health and are feeling well.

The onboard systems of the scientific research complex "Salyut-7"--"Soyuz T-11" are functioning normally.

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TASS REPORTS LAUNCH OF 'PROGRESS-22'

Moscow PRAVDA in Russian 29 May 84 p 3

[TASS Report]

[Text] In line with the program for ensuring the further functioning of the orbiting scientific station "Salyut-7", the automatic cargo ship "Progress-22" was launched from the Soviet Union on May 28, 1984, at 6:13 p.m., Moscow time.

The purpose of the ship's launching is to deliver materials that are subject to depletion and various cargo items to the orbiting station.

The "Progress-22" ship was placed into an orbit with the parameters: maximum distance from the Earth's surface--261 kilometers; minimum distance from the Earth's surface--194 kilometers; period of revolution--88.8 minutes; inclination--51.6 degrees.

According to telemetry data, the onboard systems of the automatic cargo ship are functioning normally.

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'PROGRESS-22' DOCKS WITH 'SALYUT-7'

Moscow SOVETSKAYA ROSSIYA in Russian 31 May 84 p 2

[Text] The automatic docking of the cargo ship "Progress-22" with the manned orbiting complex "Salyut-7"--"Soyuz T-11" was accomplished on May 30, 1984, at 7:47 p.m., Moscow time.

The mutual search, rendezvousing, approach and docking of the spacecraft were executed using onboard automation. These procedures were monitored by the Flight Control Center and by the crew of the orbiting complex: cosmonauts Kizim, Solov'yev and At'kov. The cargo ship is docked to the station.

The "Progress-22" ship delivered into orbit fuel for the station's combined engine assembly, equipment, instruments, and materials for scientific research.

According to the crew's reports and telemetry data, the onboard systems of the scientific research complex "Salyut-7"--"Soyuz T-11"--"Progress-22" are functioning normally.

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# COSMONAUTS BEGIN UNLOADING 'PROGRESS-22' CARGO SHIP

Moscow PRAVDA in Russian 2 Jun 84 p 1

[TASS Report]

[Text] Flight Control Center, June 1. The space mission of Leonid Kizim, Vladimir Solov'yev and Oleg At'kov on board the scientific research complex "Salyut-7"--"Soyuz T-11"--"Progress-22" is continuing.

The flight program during the days just past included technical experiments for determining parameters of the atmosphere near the complex, as well as routine preventive work on the station. A large amount of medical research was done for the purpose of objectively evaluating the condition of the crew's health and further studying effects of space-flight conditions on the human organism. The cosmonauts' psychological and physical working fitness and reactions of their cardiovascular systems to effects of physical exertion and simulated hydrostatic pressure were determined in the course of examinations.

Yesterday, the hatch of the transport spaceship "Progress-22" was opened and the cosmonauts began to unload it. Mail, foodstuffs, new instruments and materials for motion-picture and still photography were moved into the station.

Today's agenda on board the orbiting complex calls for visual observations of the waters of the world's oceans, continued work on unloading the "Progress-22" ship, and the reloading of cassettes of the multi-zonal space camera MKF-6M. Astrophysical experiments are planned during the second half of the day.

According to telemetric measurements and reports from orbit, the onboard systems and scientific apparatus of the space complex are functioning normally. Cosmonauts Kizim, Solov'yev and At'kov are healthy and feeling well. They are continuing to carry out the designated flight program with confidence.

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DEPLETION OF 'SALYUT-7' AIR BY EVA'S NOTED

Moscow PRAVDA in Russian 3 Jun 84 p 3

[Article by V. Gubarev, correspondent at Flight Control Center]

[Abstract] The brief article records comments of Flight Control Center personnel regarding results of work which the crew of the orbiting station "Salyut-7" performed recently in open space. Comparing the current mission's food, water, oxygen and materials requirements with those of earlier missions, deputy flight director Viktor Blagov mentions that consumption of these items has increased because there are now three instead of two members in the primary crew. Moreover, a portion of the station's air was lost during the cosmonauts' egresses into open space. Flights of "Progress" transport spaceships carrying supplies to the "Salyut-7" station have therefore become more frequent.

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## COSMONAUTS COMPLETE FOURTH MONTH ABOARD 'SALYUT-7'

Moscow RABOCHAYA GAZETA in Russian 9 Jun 84 p 1

[TASS Report]

[Text] Flight Control Center, June 8. The fourth month of work in near-Earth orbit by cosmonauts Leonid Kizim, Vladimir Solov'yev and Oleg At'kov has come to an end.

The flight program for the week just past included geophysical and astrophysical experiments, medical research and the unloading of the transport spaceship.

In line with the extensive program of research of the Earth's natural resources and study of the environment, the cosmonauts performed several series of visual observations and photography of various regions of the territory of the Soviet Union and the waters of the world's oceans. These experiments were conducted for the purpose of obtaining additional information on glaciers and snow cover of the Pamir Mountains, geological structures of Kyzylkumy desert and Tyan'-Shan' Mountains, and the condition of farm lands of Krasnodar Kray. Photography of the Maritime Territory and areas adjoining the Baykal-Amur Railroad was also done.

Several medical examinations were performed for the purpose of evaluating the state of the cosmonauts' health and working fitness. Data were obtained on the condition of their cardiovascular systems, the effectiveness of various physical conditioning exercises which the crew is performing regularly, and features of carbohydrate and mineral metabolism in humans who are in space-flight conditions for prolonged periods of time.

The cosmonauts will continue work in line with the program of geophysical experiments today. Three series of observations and photography of individual regions of the waters of the Atlantic and Pacific oceans are planned in accordance with assignments from oceanologists.

All members of the crew are performing medical examinations for the purpose of evaluating reactions of the circulatory system to simulated hydrostatic pressure created with aid of the "Chibis" vacuum suit. Studies will also be made of the bioelectric activity of the heart at rest.

According to results of medical monitoring and reports from orbit, the condition of the cosmonauts' health is good, and they are feeling well. The commander's pulse rate is 68 beats per minute, the flight engineer's is 72 beats per minute, and the cosmonaut-researcher's is 66 beats per minute. Their arterial pressures are 120 over 75, 115 over 70, 105 over 65 millimeters of mercury, respectively.

The onboard systems of the manned complex "Salyut-7"--"Soyuz T-11"--"Progress-22" are functioning normally.

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GEOPHYSICAL EXPERIMENTS, PHOTOGRAPHY ABOARD 'SALYUT-7'

Moscow PRAVDA in Russian 16 Jun 84 p 4

[TASS Report]

[Text] Flight Control Center, June 15. Cosmonauts Leonid Kizim, Vladimir Solov'yev and Oleg At'kov have been working on board the orbiting station "Salyut-7" for 128 days.

The crew's program of work for the days just past included studies of the Earth's surface, experiments for the study of its atmosphere and ionosphere, and the perfecting of celestial orientation methods and equipment.

Together with the scientific research, the cosmonauts did a large amount of work on unloading the transport spaceship "Progress-22". Equipment and apparatus that had been delivered were installed in their permanent places by the cosmonauts, and they replaced a group of chemical storage batteries on board the station.

One day last week was set aside for the crew's rest. The cosmonauts took showers, and meetings with their families were organized for them during period of radio and television communications.

Another cycle of geophysical experiments in line with the program of study of the Earth's natural resources is planned for today. The trans-Baykal region, the east coast of the Soviet Union's territory and the waters of the Pacific Ocean have been selected as areas for observations and photography. In these studies, the cosmonauts are using a hand-held camera and stationary cameras, as well as apparatus which operates in various electromagnetic wave bands.

According to medical monitoring data and results of an examination performed by physician O. At'kov, the condition of the crew's health is good.

The flight of the orbiting scientific research complex "Salyut-7"--"Soyuz T-11"--"Progress-22" is proceeding normally.

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CSO: 1866/197

# ORBIT OF 'SALYUT-7' STATION BOOSTED

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 23 Jun 84 p 1

[TASS Report]

[Text] Flight Control Center, June 22. Leonid Kizim, Vladimir Solov'yev and Oleg At'kov have been working on board the orbiting scientific station "Salyut-7" for 135 days.

In line with the extensive program of geophysical experiments, the cosmonauts performed several series of observations, photography and spectrometry of the Earth's land and waters of the world's oceans last week.

Today's agenda for the crew of the complex calls for routine preventive work on the station, visual observations of forest tracts in the trans-Baykal region, and physical exercises. Time is also reserved for rest.

Preparations have begun for refueling the station's combined engine assembly with fuel delivered by the "Progress-22" spaceship. The air-tightness of fuel lines is being checked today.

A correction of the orbit of the scientific research complex was made yesterday, using the cargo ship's engine. Following the correction, the parameters of the complex's orbit are: maximum distance from the Earth's surface--365 kilometers; minimum distance from the Earth's surface--328 kilometers; period of revolution--91.3 minutes; inclination--51.6 degrees.

The flight is proceeding normally. Cosmonauts Leonid Kizim, Vladimir Solov'yev and Oleg At'kov are healthy and feeling well.

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## COSMONAUTS BEGIN REFUELING OPERATIONS

Moscow PRAVDA in Russian 30 Jun 84 p 1

[TASS Report]

[Text] Flight Control Center, June 29. The space mission of Leonid Kizim, Vladimir Solov'yev and Oleg At'kov on board the orbiting complex "Salyut-7"--"Soyuz T-11"--"Progress-22" is continuing.

The flight program for the past week included geophysical and medical studies, and experiments for evaluating parameters of the atmosphere around the complex. After preparatory operations for pumping compressed nitrogen out of fuel tanks, the refueling of the station's combined engine assembly with an oxidizer was carried out.

A substantial part of the crew's work is devoted to comprehensive studies of the Earth's surface in the interests of various branches of science and the country's economy. In the past few days the crew continued gathering operational information on the condition of forest tracts in East Siberia and of glaciers in the Pamir and Tyan'-Shan' mountains.

Another examination of the crew was made in line with the program of medical monitoring. It focused in particular on determining the functional condition of the cardiovascular system and the cosmonauts' physical working fitness. Results of the examination show that Leonid Kizim, Vladimir Solov'yev and Oleg At'kov are healthy and are feeling well.

The onboard systems of the scientific research complex "Salyut-7"--"Soyuz T-11"--"Progress-22" are functioning normally.

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'SALYUT-7' CREW IN ORBIT 150 DAYS

Moscow GUDOK in Russian 7 Jul 84 p 1

[TASS Report]

[Text] Flight Control Center, July 6. Leonid Kizim, Vladimir Solov'yev and Oleg At'kov are in their 150th day of work in near-Earth orbit.

During the past week, astrophysical and geophysical experiments, medical examinations and technical experiments were conducted on board the manned complex "Salyut-7"--"Soyuz T-11"--"Progress-22".

In line with the program for study of the Earth's natural resources and environment, several series of photography of the territory of the Soviet Union and the waters of the world's oceans were carried out. The Caspian lowlands, mountain areas of the Central Asian republics, the Transbaykal region and the Maritime Kray were selected as areas for photography.

Medical monitoring was aimed at obtaining additional data on the condition of the cardiovascular system of cosmonauts during prolonged space flight.

In accordance with the station's refueling schedule, fuel was pumped from the tank of the "Progress-22" cargo spaceship into the fuel tanks of the combined engine assembly.

Today the crew is continuing geophysical experiments, and medical monitoring, maintenance work on certain instruments and the preparation of scientific equipment for forthcoming studies are planned.

According to telemetry data and reports from orbit, the onboard systems of the manned complex are functioning normally. Leonid Kizim, Vladimir Solov'yev and Oleg At'kov are in good health and are feeling well.

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CSO: 1866/197

## COMMENTARY ON COSMONAUTS' GEOLOGICAL MAPPING, PHOTOGRAPHY

Moscow PRAVDA in Russian 12 Jul 84 p 3

[Article by B. Mozhayev, Doctor of Geological-Mineralogical Sciences, general director of the "Aerogeologiya" association of the USSR Ministry of Geology]

[Abstract] The author discusses the work of geological mapping of the Earth from a spacecraft, commenting in particular on methods and equipment which crews of "Salyut" orbiting stations have used in this work.

The author mentions that geological studies in orbit are prepared by specialists of the "Aerogeologiya" association within the framework of programs of the Cosmonaut Training Center imeni Gagarin. The training of orbital mission crew members included airplane flights over Soviet territory. Flight logs are prepared for each primary mission. These logs include specific assignments, methodological instructions, and maps and space photographs indicating objects which are to be observed.

With regard to work in progress during the current "Salyut-7" mission, the author relates that cosmonauts L. Kizim, V. Solov'yev and O. At'kov are using a video complex called "Niva" in photography of the Earth's surface with stationary and portable cameras. Spectrometry and visual and instrumental observations are also being conducted.

Photographs made with the MKF-6M camera are said to possess special advantages for geological mapping purposes. Great optical and photographic enlargement of photographs is possible thanks to the camera's high geometric resolution, and images can be synthesized. The author explains that the use of synthesized images for the study of geological structures makes it possible to obtain color differentiation of objects and their boundaries which has greater contrast than that in the original photographs. The first and second photographing channels of the MKF-6 are said to possess heightened focal depth in studying the ocean floor.

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# COSMONAUTS BOOST ORBIT OF 'SALYUT-7' STATION

Moscow IZVESTIYA in Russian 14 Jul 84 p 1

[TASS Report]

[Text] Flight Control Center, July 13. Cosmonauts Leonid Kizim, Vladimir Solov'yev and Oleg At'kov are continuing planned work on board the scientific research complex "Salyut-7"--"Soyuz T-11"--"Progress-22".

An important place is assigned during the long orbital flight to investigations in line with the program for study of the Earth's natural resources. A large amount of material has been gathered pertaining to our country's mineral resources, seasonal variability of agricultural crops, and shipping and fishing conditions.

Last week the cosmonauts carried out several more series of geophysical studies. In line with assignments from meteorologists, they made observations of processes occurring in the Earth's atmosphere, routinely reporting to specialists on developing cyclones.

The crew's schedule for today calls for visual and instrument observations of land surfaces and the waters of the oceans, and physical exercise.

All planned operations with the automatic transport ship "Progress-22" have been virtually completed. Cargo items that were delivered have been put in their assigned places, fuel tanks of the station's combined engine assembly have been refilled with fuel and oxidizer, and the complex's compartments have been pressurized. The cosmonauts are putting used equipment into the emptied compartment of the cargo ship.

A correction of the scientific research complex's orbit was executed on July 11 using the "Progress-22" ship's engine. The orbit parameters at the present time are: maximum distance from the Earth's surface--358 kilometers; minimum distance from the Earth's surface--318 kilometers; period of revolution--90.1 minutes; inclination--51.6 degrees.

The flight is proceeding normally. Cosmonauts Kizim, Solov'yev and At'kov are healthy and are feeling well.

FTD/SNAP

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TASS REPORTS DESTRUCTIVE REENTRY OF 'PROGRESS-22'

Moscow IZVESTIYA in Russian 17 Jul 84 p 1

[TASS Report]

[Text] Flight Control Center, July 16. The flight of the automatic transport spaceship "Progress-22", which was launched into near-Earth orbit on May 28, 1984, has been completed.

The cargo ship docked with the "Salyut-7" station on May 30. Work planned during the joint flight of the spacecraft was carried out in its entirety, including the unloading of the spaceship and the refueling of the combined engine assembly. Three corrections of the orbit of the manned complex were executed with the aid of the cargo ship's engine.

The "Progress-22" spaceship was undocked from the "Salyut-7" station on July 15, at 5:36 p.m., Moscow time. The spaceship's engine was fired at the calculated time. As a result of braking, the cargo ship went into a descending trajectory, entered the dense layers of the atmosphere and ceased to exist.

Leonid Kizim, Vladimir Solov'yev and Oleg At'kov are in the 160th day of their orbital flight. The cosmonauts are resting today. Their plans call for engaging in physical exercises, cleaning the complex's rooms and taking showers.

According to results of medical monitoring, the condition of the crew's health is good. The flight of the scientific research complex "Salyut-7"--"Soyuz T-11" is proceeding normally.

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TASS REPORTS LAUNCH OF 'SOYUZ T-12'

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 18 Jul 84 p 1

[TASS Report]

[Text] In accordance with the program of research of outer space, the spaceship "Soyuz T-12" was launched from the Soviet Union on July 17, 1984, at 9:41 p.m., Moscow time. The spaceship is piloted by a crew consisting of Colonel Vladimir Aleksandrovich Dzhanibekov, Pilot-Cosmonaut of the USSR, twice Hero of the Soviet Union and the ship's commander; Svetlana Yevgen'yevna Savitskaya, Pilot-Cosmonaut of the USSR, Hero of the Soviet Union and flight engineer; and cosmonaut-researcher Igor' Petrovich Volk.

The ship's flight program calls for docking with the orbiting complex "Salyut-7"--"Soyuz T-11". Vladimir Dzhanibekov, Svetlana Savitskaya and Igor' Volk are to perform scientific and technical research and experiments jointly with Leonid Kizim, Vladimir Solov'yev and Oleg At'kov, who have been working on board the manned complex since February 9, 1984.

The onboard systems of the "Soyuz T-12" spaceship are functioning normally. Vladimir Dzhanibekov, Svetlana Savitskaya and Igor' Volk are feeling well. The crew of the "Soyuz T-12" spaceship has begun carrying out the designated flight program.

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CSO: 1866/197

## BIOSKETCHES OF COSMONAUTS DZHANIBEKOV, SAVITSKAYA AND VOLK

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 18 Jul 84 p 1

[Text] Vladimir Aleksandrovich Dzhaniibekov, Pilot-Cosmonaut of the USSR, twice Hero of the Soviet Union, was born on May 13, 1942, in the settlement of Iskandar, Bostanlyk Rayon, Tashkent Oblast.

After graduating from the Yeysk Higher Military Aviation School for Pilots in 1965, he served as a pilot-instructor in the Air Force.

V. A. Dzhaniibekov has been a member of the Communist Party of the Soviet Union since 1970.

He was enrolled in the contingent of cosmonauts in 1970.

V. Z. Dzhaniibekov has made three space flights. In January of 1978, he was commander of the spaceship "Soyuz-27", which delivered the first visiting expedition to the "Salyut-6" station.

In March of 1981, Vladimir Aleksandrovich made a flight on the spaceship "Soyuz-39" as commander of an international Soviet-Mongolian crew which performed research and experiments on board the "Salyut-6" station.

On his third flight, which was made in the summer of 1982, he was commander of an international Soviet-French crew which worked on board the "Soyuz T-6" spaceship and the orbiting station "Salyut-7".

\* \* \*

Svetlana Yevgen'yevna Savitskaya, Pilot-Cosmonaut of the USSR, Hero of the Soviet Union, was born in Moscow on August 8, 1948.

She worked as a pilot-instructor after graduating from the Central Flight Technical School of the USSR All-Union Volunteer Society for Assistance to the Army, Air Force and Navy, and from the Moscow Aviation Institute imeni Ordzhonikidze.



S. Ye. Savitskaya has been a member of the Communist Party of the Soviet Union since 1975. She is a member of the Central Committee of the All-Union Leninist Communist Youth League.

Beginning in 1976, S. Ye. Savitskaya was engaged in testing work while undergoing a course of instruction in a school for test-pilots. She has mastered more than 20 types of airplanes and holds the professional title "Test-pilot, second class".

Svetlana Yevgen'yevna is a meritorious master of sports of the USSR, has set 18 world aviation records and was the world champion in higher aerobatics in 1970.

S. Ye. Savitskaya is now working in a design bureau and taking part in the testing of spacecraft.

She was enrolled in the contingent of cosmonauts in 1980.

S. Ye. Savitskaya made her first space flight in August of 1982, as a cosmonaut-researcher on board the "Soyuz T-7" spaceship and the orbiting station "Salyut-7".

\* \* \*

Igor' Petrovich Volk was born on April 12, 1937, in the city of Gotval'd, Khar'kov Oblast.

He served in the Air Force after graduating from the Kirovograd Military Aviation School for Pilots in 1956.

I. P. Volk has been a member of the Communist Party of the Soviet Union since 1964.

I. P. Volk was engaged in testing work after graduating from a school for test-pilots in 1965. He proved himself to be a highly skilled specialist capable of performing flights of a high degree of difficulty.

I. P. Volk holds the professional title "Test-pilot, first class". The honorary title "Meritorious Test-pilot of the USSR" has been conferred upon him. He has spent more than 4,700 hours in flight, 2,700 of them in testing work.

He completed studies at the Moscow Aviation Institute imeni Ordzhonikidze in 1969 without leaving his regular work.

I. P. Volk began to train for space flights in 1978. He has completed a full course of training for flights on board the Soyuz T" spaceship and the orbiting station "Salyut".

(A photograph is given showing V. A. Dzhanibekov, S. Ye. Savitskaya and I. P. Volk in their space suits.)

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'SOYUZ T-12' PREPARES FOR DOCKING

Moscow PRAVDA in Russian 19 Jul 84 p 1

[TASS Reports]

[Text] Flight Control Center, July 18. As of 12:00 o'clock noon, Moscow time, 10 revolutions around the earth had been completed by the spaceship "Soyuz T-12", which is piloted by a crew consisting of V. A. Dzhanibekov, S. Ye. Savitskaya and I. P. Volk.

In accordance with the flight program, the cosmonauts have checked the airtightness of the spaceship's compartments and the functioning of its onboard systems, and they have carried out prescribed orientation routines. The first two-pulse maneuver for the approach to the scientific research complex "Salyut-7"--"Soyuz T-11" was executed on the fourth and fifth orbits.

According to results of trajectory measurements, the parameters of the "Soyuz T-12" spaceship's orbit at the present time are: maximum distance from the Earth's surface--309 kilometers; minimum distance from the Earth's surface--282 kilometers; period of revolution--90.2 minutes; inclination--51.6 degrees.

The flight is proceeding normally.

Cosmonauts Svetlana Savitskaya, Vladimir Dzhanibekov and Igor' Volk are feeling well.

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'SOYUZ T-12' DOCKS WITH 'SALYUT-7' STATION

Moscow IZVESTIYA in Russian 20 Jul 84 p 1

[Text] The spaceship "Soyuz T-12" docked with the orbiting complex "Salyut-7"--"Soyuz T-11", which is piloted by a crew consisting of Leonid Kizim, Vladimir Solov'yev and Oleg At'kov, on July 18 at 11:17 p.m., Moscow time.

After checking the seal of the docking mechanism, Vladimir Dzhaniybekov, Svetlana Savitskaya and Igor' Volk went inside the "Salyut-7" station. Six Soviet cosmonauts, including a woman cosmonaut, are working in near-Earth space on board the scientific research complex "Salyut-7"--"Soyuz T-11"--"Soyuz T-12".

The program of the joint mission calls for technical and technological experiments, observations and photography of the Earth's surface, and medical-biological, astrophysical and other studies.

According to telemetry data, the onboard systems of the scientific research complex "Salyut-7"--"Soyuz T-11"--"Soyuz T-12" are functioning normally. Leonid Kizim, Vladimir Solov'yev, Oleg At'kov, Vladimir Dzhaniybekov, Svetlana Savitskaya and Igor' Volk are feeling well.

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TASS REPORTS MEDICAL, MATERIALS STUDIES ABOARD 'SALYUT-7'

Moscow PRAVDA in Russian 21 Jul 84 p 1

[TASS Report]

[Text] Flight Control Center, July 20. Cosmonauts Leonid Kizim, Vladimir Solov'yev, Oleg At'kov, Vladimir Dzhanibekov, Svetlana Savitskaya and Igor' Volk are continuing their work on board the orbiting complex "Salyut-7"--"Soyuz T-11"--"Soyuz T-12".

During their first days on board the station, the crew of the visiting expedition performed a series of medical studies for the purpose of medical studies of obtaining additional information on effects of space-flight conditions on the human organism, as well as processes of adaptation to weightlessness. The functional condition of the cosmonauts' cardiovascular systems was studied, and the acuity and depth of their vision and the degree of fatigue of their eyes were determined. Experiments called "Pnevmatik" and "Profilaktika" were performed for the purpose of perfecting methods and equipment for preventing adverse effects of weightlessness during the initial stage of flight.

A biological experiment called "Tsitos-3", which was prepared by Soviet and French scientists, has begun on board the orbiting complex.

An experiment called "Tamponazh" (plugging) has been performed in line with the technological research plan. The purpose of this experiment is to obtain sealing mixtures from various model materials in zero gravity. Comparative analysis of specimens obtained on Earth and in conditions of microgravitation will permit fuller study of mechanisms of the formation of microstructures during the solidification of plugging mortars which are used for sealing oil and gas wells.

According to results of medical monitoring and reports from orbit, the health of Svetlana Savitskaya, Leonid Kizim, Vladimir Solov'yev, Oleg At'kov, Vladimir Dzhanibekov and Igor' Volk is good, and they are feeling well.

The flight of the scientific research complex "Salyut-7"--"Soyuz T-11"--"Soyuz T-12" is proceeding normally.

COMMENTARY ON 'SALYUT-7' ELECTROPHORESIS, PLUGGING MORTAR EXPERIMENTS

Moscow PRAVDA in Russian 21 Jul 84 p 6

[Article by V. Gubarev, special correspondent at the Flight Control Center]

[Abstract] The article provides information on two experiments which were scheduled on the orbiting station "Salyut-7" during the stay of the visiting crew consisting of Vladimir Dzhanibekov, Svetlana Savitskaya and Igor' Volk.

Cosmonaut Aleksandr Serebrov is quoted in regard to the experiment called "Tavriya" which he had begun during a previous mission and which Savitskaya was scheduled to continue. This experiment is aimed at obtaining extra-pure substances as a basis for the semi-industrial production of certain drugs. In the experiment, a protein solution is pumped into a special container, an electric field is turned on, and the protein separates into four fractions. Enough preparation to last a research institute a month can be obtained in a few hours with the "Tavriya" unit, according to Serebrov. Preparations obtained in space are 15 to 20 times as pure as those produced on Earth.

Dzhanibekov was doing an experiment requested by industry specialists who are working on the problem of reducing losses of oil and gas during well-drilling. It is explained that oil and gas under pressure seep through pores in the plugging mortar which fills the space between the casing pipe of the borehole and the ground. In Dzhanibekov's experiment, three cubes were to be obtained from three different types of mortar. The hardened cubes were to be returned to Earth with the visiting crew. The purpose of this experiment is to help ascertain how the process of pore formation proceeds in mortar and whether a relationship exists between this process and the settling of particles.

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# TASS REPORTS EXPERIMENTS DURING VISITING CREW'S THIRD DAY

Moscow PRAVDA in Russian 22 Jul 84 p 1

[TASS Report]

[Text] Flight Control Center, July 21. For the third day on board the orbiting scientific station "Salyut-7", Vladimir Dzhanibekov, Svetlana Savitskaya and Igor' Volk are pursuing joint research with the primary crew--Leonid Kizim, Vladimir Solov'yev and Oleg At'kov.

Today's program calls for performing technological and medical-biological experiments, visual observations of the Earth's surface, still and motion-picture photography of joint work, and a television report.

Work has begun on separating biological preparations in an electric field with the improved "Tavriya" unit. The purpose of this work is to obtain experimental lots of superpure substances and effective new medicinal preparations in conditions of zero gravity. An anti-infectious preparation obtained by a genetic-engineering method is being purified in one of this unit's electrophoretic chambers today. The division of cells which produce an antibiotic is being accomplished in another chamber. This antibiotic is a medicine and a stimulator of the growth of biomass and the increase of farm animals' productivity.

An experiment for determining how open space affects various structural materials has been performed in line with the space materials-science program. Specimens under study were exposed in a depressurized airlock chamber, and their condition was monitored with the aid of the "Elektrotopograf" apparatus.

The biological experiment "Tsitoz-3", which was begun on July 19, is continuing on board the orbiting complex. The purpose of this experiment is to study the effect of space-flight factors on the permeability of the cell membranes of microorganisms and on other characteristics of their vital activity.

According to results of telemetric measurements and the crew's reports, the onboard systems of the orbiting scientific research complex "Salyut-7"--"Soyuz T-11"--"Soyuz T-12" are functioning normally.



Cosmonauts Svetlana Savitskaya, Leonid Kizim, Vladimir Solov'yev, Oleg At'kov, Vladimir Dzhanibekov and Igor' Volk are feeling well, and the condition of their health is good.

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## COMMENTARY ON DERIVATION OF BIOLOGICAL MATERIALS, COSMONAUT ADAPTATION

Moscow IZVESTIYA in Russian 22 Jul 84 p 3

[Article by A. Ivakhnov, special correspondent at the Flight Control Center]

[Abstract] The article records conversations with specialists at the Flight Control Center regarding the latest series of medical and biological experiments which were scheduled for performance on board the orbiting station "Salyut-7".

Candidate of Medical Sciences A. Lepskiy commented on the progress of experiments for obtaining superpure substances in the "Tavriya" unit, which were begun during previous space missions. He related that results of the initial experiments in this series have convinced specialists that it is both possible and economically advantageous to obtain, in space, superpure biological preparations in quantities sufficient for practical employment in public health and agriculture. An extrapure antiserum which is now being used as a standard in the production of standard vaccines was manufactured with the aid of a preparation delivered to Earth by cosmonauts Lyakhov and Aleksandrov, for example. This preparation was obtained from the membrane of the influenza virus. The flight program of the visitin crew consisting of Svetlana Savitskaya, Vladimir Dzhanibekov and Igor' Volk calls for obtaining additional lots of this preparation for medical institutes. A small portion of this substance will be used to obtain so-called diagnosticums for the routine determination of viral strains that cause epidemics at particular times.

Plans for the latest experiments with the "Tavriya" unit call also for work aimed at isolating microorganisms which are efficient producers of fodder antibiotics, and at obtaining certain medical preparations which are free of undesirable impurities. A valuable medicinal protein was to be refined from a preparation obtained on Earth by a genetic-engineering method, for example.

Deputy flight director Viktor Dmitriyevich Blagov is quoted in regard to an experiment aimed at broadening scientists' understanding of various organs' reactions to effects of space-flight factors. Unlike the other crew members, cosmonaut-researcher Volk, who was taking part in this experiment, was performing no physical exercises on board the space station. His organism

was functioning in what Blagov called more difficult conditions. Since his arrival in orbit, Volk had been regularly taking tablets which reduce unpleasant sensations usually experienced by cosmonauts during the first days of an orbital mission. The condition of Volk's organism was being carefully monitored by cosmonaut-physician O. At'kov in the course of this experiment.

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'TSITOS' AND 'TAVRIYA' EXPERIMENTS ON 'SALYUT-7'

Moscow SOVETSKAYA ROSSIYA 22 Jul 84 p 6

[Article by B. Gerasimov, special correspondent at the Flight Control Center]

[Abstract] The article mentions some of the activities which were in progress on board the orbiting station "Salyut-7" during the stay of the latest visiting crew, whose members included cosmonaut Svetlana Savitskaya. Specialists at the Flight Control Center and crew members are quoted in regard to meals which the cosmonauts on the station were preparing and the program of medical-biological research which they were carrying out.

A. A. Lepskiy, a USSR State Prize laureate and one of the developers of this program, commented on results of work which has been done with the experimental units "Tsitos" and "Tavriya" on board "Salyut-7". The studies of the origin, development and destruction of living cells. Lepskiy related that experiments performed in this unit during the space mission of a Soviet-French crew yielded remarkable results. They have enabled scientists to ascertain the resistance of microbes to various antibiotics, in particular. The "Tsitos" unit which Savitskaya was using in the latest series of experiments is said to be a new, modernized one. Whereas the "Tsitos" is used chiefly for basic research, results of space experiments with the "Tavriya" have already been introduced into medical clinics' practice. Superpure preparations for immunology have been obtained which are difficult and costly to produce in terrestrial conditions, for example. Lepskiy mentioned that scientists of the Institute imeni Pasteur in Leningrad contributed ideas to the program of research with the "Tavriya".

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## JOINT CREW CONTINUES WORK ABOARD 'SALYUT-7'

Moscow PRAVDA in Russian 23 Jul 84 p 1

[TASS Report]

[Text] Flight Control Center, July 22. Cosmonauts Leonid Kizim, Vladimir Solov'yev, Oleg At'kov, Vladimir Dzhanibekov, Svetlana Savitskaya and Igor' Volk are continuing their joint work on board the orbiting scientific station "Salyut-7".

On today's program are biotechnological experiments, medical research and visual observations of areas of land and of waters of the world's oceans.

The latest cycle of electrophoretic separation of a mixture of biologically active substances has been carried out in the "Tavriya" unit. The purpose of today's work was to obtain, from the membranes of various influenza viruses, preparations of high purity for the preparation of effective new influenza vaccines.

The medical portion of today's flight program is represented by experiments called "Pnevmatik" and "Anketa" (questionnaire), in the course of which an evaluation is made of the effectiveness of means of preventing adverse effects of weightlessness on the human organism, and the causes of vestibular disturbances during the initial stage of a flight are studied.

Today's agenda calls for conducting still another "Elektrotopograf" experiment. These experiments are being performed in line with an expanded program of research which specialists drafted, taking into account results of the processing of specimens and electrotopograms which were obtained earlier.

During a period of television communication in the evening, the cosmonauts will tell about the work they are doing on board the scientific research complex.

The flight is proceeding normally. The condition of the health of Svetlana Savitskaya, Leonid Kizim, Vladimir Solov'yev, Oleg At'kov, Vladimir Dzhanibekov and Igor' Volk is good, and they are feeling well.

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CSO: 1866/197

TASS REPORTS ASTROPHYSICAL, ATMOSPHERIC STUDIES ON 'SALYUT-7'

Moscow PRAVDA in Russian 24 Jul 84 p 1

[TASS Report]

[Text] Flight Control Center, July 23. Cosmonauts Leonid Kizim, Vladimir Solov'yev, Oleg At'kov, Vladimir Dzhanibekov, Svetlana Savitskaya and Igor' Volk are continuing to carry out the joint flight program on board the orbiting scientific station "Salyut-7".

In the days just past the crew of the visiting expedition conducted an extensive set of medical examinations. Their results showed that the process of adaptation to zero gravity is proceeding well with Svetlana Savitskaya, Vladimir Dzhanibekov and Igor' Volk.

The working day on the station began today at 9 a.m. and will last until 12 midnight, Moscow time. In line with the program of astrophysical studies, a number of the "Piramig" series of experiments are planned for the study of the distribution of interplanetary matter in space.

The purpose of an experiment called "Ekstinktsiya", which is being conducted in line with the geophysical research program, is to determine the density of aerosol layers of cosmic origin in the Earth's atmosphere. The experiment is being performed with the EFO-1 photoelectric photometer. It consists of measuring the change in brightness of stars as they set behind the atmosphere and thereby getting a cross-section of the layer of aerosols.

According to telemetry readings and reports from orbit, the flight of the scientific research complex "Salyut-7"--"Soyuz T-12" is proceeding normally.

Cosmonauts Svetlana Savitskaya, Leonid Kizim, Vladimir Solov'yev, Oleg At'kov, Vladimir Dzhanibekov and Igor' Volk are healthy and are feeling well.

FTD/SNAP

CSO: 1866/197



## SIXTH DAY OF VISITING CREW ABOARD 'SALYUT-7'

Moscow KRASNAYA ZVEZDA in Russian 26 Jul 84 p 1

[TASS Report]

[Text] Flight Control Center, July 24. The crew of cosmonauts--Leonid Kizim, Vladimir Solov'yev, Oleg At'kov, Vladimir Dzhanibekov, Svetlana Savitskaya and Igor' Volk--is successfully continuing its planned work on board the orbiting complex "Salyut-7"--"Soyuz T-11"--"Soyuz T-12".

The agenda for the sixth day of the joint flight calls for medical-biological and technological studies, preparing apparatus and equipment for upcoming experiments and engaging in physical exercises. Time is also reserved for rest.

The latest cycle of work on electrophoretic separation of various biological preparations in conditions of zero gravity is being carried out today in the "Tavriya" unit. A biologically active anti-infective substance obtained by a genetic-engineering method is being purified in one of this unit's chambers, and a superpure preparation is being separated from antigens of the influenza virus in a second chamber. This preparation is intended for the production of highly effective preventive vaccines and serums. Employed in the "Tavriya" unit are new systems and apparatus which are prototypes of promising semiautomatic units for space biotechnology.

One more series of "Elektrotopograf" experiments has begun within the framework of the space materials-science program. The purpose of these experiments is to study dynamics of change of various materials' characteristics from the comprehensive effect of space factors, and also to perfect methods of diagnosing the condition of these materials directly on board the orbiting station. Both model materials and composite materials are being used as specimens, including components of these materials. As compared with previous experiments, time for the exposure of specimens in open space has been increased, and photographic films that are more sensitive to an electric field are being employed.

According to telemetric information, the flight of the orbiting complex is proceeding normally. All of the cosmonauts are healthy and feeling well.

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CSO: 1866/197

COMMENTARY ON 'ELEKTROTOPOGRAF' EXPERIMENTS

Moscow IZVESTIYA in Russian 26 Jul 84 p 3

[Article by A. Ivakhnov, special correspondent at the Flight Control Center]

[Abstract] The article records comments of specialists at the Flight Control Center regarding adaptation and materials-science experiments which were in progress on board the orbiting station "Salyut-7" during the mission of the "Pamirs"--the visiting crew consisting of V. Dzhanibekov, S. Savitskaya and I. Volk.

Aleksandr Yevgen'yevich Kravtsov, a science associate of the Ukrainian Academy of sciences' Institute of Physics, mentioned interesting results of the first two series of experiments with the "Elektrotopograf" unit, which were performed on board the space station by cosmonauts V. Lyakhov and A. Aleksandrov last year. In the course of these experiments, specimens of materials which are under study are exposed to open space for a certain period of time, and effects of space factors on these materials are subsequently determined with the aid of photographic films placed against the specimens. Lyakhov's and Aleksandrov's experiments indicated, for example, that the breakdown of materials exposed in space proceeds at an uneven rate, accelerations alternating with slow-downs. Comparing the methods of these experiments with those of the latest series, Kravtsov related: "This time, the 'Pamirs' brought with them not only model materials but also structural ones and individual components of these materials. Highly sensitive black-and-white and color films are being used in the experiment. The previous experiments indicated that color films which have a layered structure provide far more information: traces of micrometeorites are imprinted on one layer, results of the action of charged particles on another, etc."

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'SALYUT-7' MANEUVER EXECUTED FOR ELECTROTOPOGRAPHY EXPERIMENT

Moscow PRAVDA in Russian 26 Jul 84 p 6

[Article by V. Gubarev, special correspondent at the Flight Control Center]

[Abstract] The article records conversations during periods of communications with visiting cosmonauts Svetlana Savitskaya and Igor' Volk on board the orbiting station "Salyut-7", and with members of the station's primary crew, whose commander is Leonid Kizim. Specialists' comments on the cosmonauts' work are also recorded.

Space materials-science experiments scheduled for performance on board "Salyut-7" during the period July 19-26 were called very interesting by A. Kravtsov, an associate of the Ukrainian Academy of Sciences' Institute of Physics. It is mentioned that the visiting crew delivered to the space station a new series of specimens for an experiment with the "Elektrotopograf" unit, and that such experiments are traditionally conducted by the commander of the primary crew. Kizim is credited with proposing, for the latest experiment, a new method of exposing these specimens to open space in an airlock chamber of the station. This proposal called for maneuvering the station, using its engine, so that this chamber would be directed at the sun. Time for ensuring the necessary temperature conditions in the chamber could thus be reduced from approximately six hours to a few minutes. Initial tests reportedly demonstrated the effectiveness of this method; Kizim removed specimens from the chamber for study only 10 minutes after the airlock's hatch had been closed. Kravtsov mentioned that the chamber had been opened for 40 hours while the experiment was in progress.

FTD/SNAP

CSO: 1866/197

## RESULTS FROM 'TAVRIYA' EXPERIMENT

Leningrad LENINGRADSKAYA PRAVDA in Russian 28 Jul 84 p 4

[Article by T. Chesanova]

[Abstract] The article comments on the medical significance of extra-pure substances which have been obtained with the aid of the biotechnology complex "Tavriya" on board the orbiting station "Salyut-7". A. A. Lepskiy, a USSR State Prize laureate and one of the directors of the program of biological research with the "Tavriya", related that specific results of this research are already being employed in public-health practice. The Leningrad Scientific Institute of Epidemiology and Microbiology imeni Pasteur is identified as one of the organizations that are utilizing results of this work. A. I. Krashenyuk, senior science associate of this institute, mentioned that it is collaborating closely with various Soviet institutions in this connection. It is particularly indebted to two associates of the Simferopol' Medical Institute who are leading figures in the field of space biotechnology: G. V. Troitskiy, corresponding member of the Ukrainian Academy of Sciences, and Candidate of Medical Sciences G. Yu. Azhitskiy.

Particular attention is devoted to the prospective uses of an extra-pure hemagglutinin—a surface protein of the influenza virus—which was obtained on board "Salyut-7" by the crew consisting of V. Lyakhov and A. Aleksandrov. Biophysicists of the epidemiology institute received the first experimental lot of this preparation a few months ago, and Krashenyuk and his colleagues subsequently developed immune serums on its basis. These serums can be used for standardizing vaccines and for monitoring inactivated-vaccine production processes, according to results of tests conducted jointly with personnel of the Leningrad Scientific Research Institute of Vaccines and Serums.

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CSO: 1866/197

'GENOM' ELECTROPHORESIS EXPERIMENT ON 'SALYUT-7'

Leningrad LENINGRADSKAYA PRAVDA in Russian 22 Jul 84 p 4

[Article by V. Ovcharov, special correspondent at the Flight Control Center]

[Excerpt] "We have a very full program, and therefore we shall begin our work in the morning." That is what Vladimir Dzhanibekov said during a nighttime television report from the "Salyut-7" station immediately after the crew under his command had gone into it.

One remembers how enthusiastically Svetlana Savitskaya worked with the "Tavriya" unit during her first flight. She is now continuing this extremely interesting experiment.

Whereas human blood proteins and cells from the bone marrow of small mammals served as model specimens in the initial electrophoretic-separation experiments, the amazing compound deoxyribonucleic acid (DNA) has now been selected as the material for study in an experiment called "Genom". A special electrophoretic chamber was developed for the purpose of fractionating DNA, which is structurally one of the most complex heredity substances.

This chamber is a cylinder 90 centimeters long. Placed along the entire length of the cylinder are 230 needles capable of drawing off fractions separated by an electric field.

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## EVA OF COSMONAUTS SAVITSKAYA AND DZHANIBEKOV

Moscow KOMSOMOL'SKAYA PRAVDA in Russian 27 Jul 84 p 1

[TASS Report]

[Text] In line with the flight program of the orbiting scientific research complex "Salyut-7"---"Soyuz T-11"---"Soyuz T-12", cosmonauts Svetlana Savitskaya and Vladimir Dzhanibekov made an egress into open space on July 25, 1984.

The main task of this egress was to conduct tests of a new multipurpose hand tool which is intended for the performance of complex technological operations. The woman cosmonaut took an active part in this work.

The cosmonauts opened an outer hatch of the station and went outside it at 6:55 p.m., Moscow time. In the entry compartment, they set up and prepared for operation a portable electron-beam unit, a control desk, a converter and boards holding specimens of metal. With the aid of the multipurpose hand tool, Svetlana Savitskaya performed, in succession, operations for cutting, welding and soldering metal plates, and spray-coating operations. During this time, Vladimir Dzhanibekov took motion pictures and made a television report. The cosmonauts then exchanged places, and the commander of the visiting crew performed a cycle of technological operations with other specimens. The equipment and specimens that were obtained were returned to the entry compartment following the completion of this work.

During the final stage of their egress, the cosmonauts also dismantled panels that had been installed previously on the outer surface of the station and took them inside it. These panels contained various structural materials which had been in conditions of open space for a long time.

After successfully performing their planned work, Svetlana Savitskaya and Vladimir Dzhanibekov returned to the station. The total time that they spent in conditions of open space was 3 hours and 35 minutes.

While the work in open space was in progress, cosmonauts Lenoid Kizim, Vladimir Solov'yev, Oleg At'kov and Igor' Volk monitored the functioning of systems of the station and of space suits and maintained radio communication with Svetlana Savitskaya and Vladimir Dzhanibekov.



The crew of the orbiting complex operated smoothly and confidently and in complete accordance with the planned schedule during the performance of the work in open space. The condition of the cosmonauts' health is good.

The world's first egress into open space by a woman cosmonaut has been made by Svetlana Savitskaya. Her successful performance of unique experiments in conditions of outer space demonstrated that it is possible for a woman to function effectively while performing complex work not only on board a manned orbiting complex but also in open space.

FTD/SNAP

CSO: 1866/197

COMMENTARY ON HAND TOOL USED IN COSMONAUT EVA

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 27 Jul 84 p 1

[Article by G. Lomanov, special correspondent at the Flight Control Center]

[Abstract] The article provides information on equipment which cosmonauts S. Savitskaya and V. Dzhanibekov used to perform welding and spray-coating experiments during their recent egress from the orbiting station "Salyut-7".

A conversation held in March of this year with Candidate of Technical Sciences V. Lapchinskiy, head of a laboratory of the Institute of Electric Welding imeni Paton, is recalled. Lapchinskiy recounted work which he and his colleagues did on a multipurpose hand tool (URI) for space installation operations. A variant of this tool was employed in the "Salyut-7" experiments. Lapchinskiy mentioned that its development was made possible by metal vaporization and deposition experiments performed in the "Isparitel'" unit during earlier space missions. A manual device which cosmonauts could use in open space was developed on the basis of this unit's electron-beam gun, which weighs 1.5 kilograms. (The "Isparitel'" as a whole is said to weigh about 30 kilograms.) A variant of this device was successfully tested in a laboratory airplane, during brief periods of zero gravity.

The URI which Savitskaya and Dzhanibekov employed is said to be part of a small unit including converters and a control system. This unit can be fastened with clamps to handrails of the "Salyut-7" station. On one side of the unit are four folding, board-type holders for specimens. The URI, which is connected to the unit by a cable, resembles a hand-held camera with two lens barrels. One is intended for cutting, welding and soldering metals; the other for applying coatings.

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#### FURTHER DETAILS ON WELDING, SPRAY-COATING TOOL

Moscow IZVESTIYA in Russian 27 Jul 84 p 3

[Article by A. Ivakhnov, special correspondent at the Flight Control Center]

[Abstract] The article gives an account of activities on board the orbiting station "Salyut-7" during the recent egress of cosmonauts Vladimir Dzhanibekov and Svetlana Savitskaya into open space. Particular attention is devoted to welding and spray-coating operations which the two cosmonauts performed outside the station with the aid of a multipurpose hand tool (URI).

The entire URI unit is said to appear capable of fitting into a box half a meter square. The main part of this unit somewhat resembles a flare pistol with two broad barrels, one of which has a lens on it. A powerful electron beam generated inside this barrel is focused, with the aid of the lens, onto metal specimens of various shapes, which are cut, welded or soldered by means of the beam. The second barrel is intended for spray-coating other specimens with silver. This barrel has a built-in crucible for melting the silver. The URI unit includes four board-type holders on which specimens are placed. Three of these boards hold specimens during cutting, welding and soldering operations. Each one holds six specimens: two made of rustproof metals and four made of titanium. The fourth board holds specimens that are spray-coated.

It is mentioned that the cosmonauts' work with the URI was monitored by television. During the welding of several specimens in succession, the temperature of their holders was monitored with the aid of a pistol-shaped, non-contact infrared thermometer. Following the completion of this work, specimens in containers were removed from the URI unit for subsequent delivery to Earth with the visiting crew. Before going back inside the station, the cosmonauts replaced various specimens which had been exposed to space conditions in line with another experiment, which is called "Ekspozitsiya".

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CSO: 1866/197

'SALYUT-7' COSMONAUT ACTIVITIES FOR 26 JULY

Moscow IZVESTIYA in Russian 27 Jul 84 p 1

[TASS Report]

[Text] Flight Control Center, July 26. Yesterday, the working day of Leonid Kizim, Vladimir Solov'yev, Oleg At'kov, Vladimir Dzhanibekov, Svetlana Savitskaya and Igor' Volk ended late at night, and today they rested until 12:00 noon, Moscow time. After having breakfast and monitoring individual systems of the orbiting complex, the cosmonauts continued their planned joint research.

A substantial portion of today's agenda is reserved for geophysical studies. In accordance with assignments from specialists, the crew is performing a series of visual and instrumental observations and photography of our country's southern regions and the basins of the Caspian and Black seas. A number of experiments using the "Piramig" camera and the mass-spectrometry apparatus "Astra-1" will be conducted for the purpose of studying the structure of the Earth's atmosphere and determining parameters of the atmosphere immediately surrounding the orbiting complex.

In line with the space materials-science program, the cosmonauts will perform the final operations in the "Elektrotopograf" experiment today. They will remove specimens of materials that are under study from an airlock chamber, inspect them and prepare them for returning to Earth.

Today's program calls also for a number of medical examinations of the crew of the visiting expedition, experiments for perfecting space navigation methods, and still and motion-picture photography of joint work.

The flight of the orbiting scientific research complex "Salyut-7"--"Soyuz T-11"--"Soyuz T-12" is proceeding normally.

All six cosmonauts are healthy and working smoothly, and their morale is good.

FTD/SNAP  
CSO: 1866/197

## VISITING CREW PREPARES FOR RETURN TO EARTH

Moscow PRAVDA in Russian 29 Jul 84 p 1

[Text] The orbital flight of Vladimir Dzhanibekov, Svetlana Savitskaya and Igor' Volk is nearing completion. They have been working jointly with Leonid Kizim, Vladimir Solov'yev and Oleg At'kov on board the "Salyut-7" station since July 19. The cosmonauts are performing the final experiments of their program of scientific and technical research and preparing for the return to Earth.

In accordance with assignments from specialists, today the crew is conducting the latest series of visual observations and photography of individual regions of the Soviet Union's territory, particularly republics of Central Asia and the southern USSR.

A technical experiment has been performed for the purpose of evaluating the effectiveness of various materials that are employed in filters for removing harmful impurities from the atmosphere of manned spacecraft.

Preparations have begun for the descent from orbit of the transport spaceship "Soyuz T-12", in which the crew of the visiting expeditions will return to Earth. Materials from studies carried out on board the "Salyut-7" station are being stowed by the cosmonauts in this spaceship's reentry vehicle, and used equipment is being stowed in its living compartment. Today's plans call also for a check of the functioning of onboard systems of the spaceship, as well as a test firing of its engine.

All work on board the orbiting complex "Salyut-7"--"Soyuz T-11"--"Soyuz T-12" is being performed in strict accordance with the planned schedule. Cosmonauts Svetlana Savitskaya, Leonid Kizim, Vladimir Solov'yev, Oleg At'kov, Vladimir Dzhanibekov and Igor' Volk are healthy and feeling well.

FTD/SNAP

CSO: 1866/197

'SOYUZ T-12' COSMONAUTS RETURN TO EARTH

Moscow KOMSOMOL'SKAYA PRAVDA in Russian 31 Jul 84 p 1

[TASS Report]

[Excerpt] After completing the program of their joint work on board the scientific research complex "Salyut-7"--"Soyuz T-11"--"Soyuz T-12", cosmonauts Vladimir Dzhanibekov, Svetlana Savitskaya and Igor' Volk returned to Earth on July 29, 1984, at 4:55 p.m., Moscow time. Leonid Kizim, Vladimir Solov'yev and Oleg At'kov are continuing their flight on board the orbiting station "Salyut-7".

The reentry vehicle of the "Soyuz T-12" spaceship made a landing in the prescribed region of the territory of the Soviet Union, 140 kilometers southeast of the city of Dzhezkazgan. Comrades Dzhanibekov, Savitskaya and Volk are feeling well after the landing.

The planned program of scientific and technical research and experiments was carried out in its entirety during the work of the crew consisting of six cosmonauts on board the orbiting complex.

An important place in the crew's work program was reserved for space technology and biotechnology experiments. Delivered to Earth were super-pure, biologically active substances obtained in conditions of zero gravity, as well as specimens of structural material that had been in open space for a long time.

(A photograph is given showing the cosmonauts in their space suits, after their return.)

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## ADAPTATION, POST-FLIGHT CONDITION OF 'SOYUZ T-12' COSMONAUTS

Moscow MEDITSINSKAYA GAZETA in Russian 1 Aug 84 p 4

[Article by V. Pishchik]

[Excerpt] The Baykonur spaceport has given a warm welcome to Vladimir Dzhanibekov, Svetlana Savitskaya and Igor' Volk after their 12 days of intensive work in orbit. Now come reports, analysis of completed work and meetings with specialists.

Initial studies of the cosmonauts' cardiovascular systems and skeletal-muscular and vestibular apparatuses both at rest and while various functional exertions are producing effects have already shown that they endured the flight well and are reacting adequately to terrestrial gravity. This has been confirmed by data from biochemical studies of the blood that characterize metabolic processes, the activity of enzymes and a number of hormonal indices, which are within the limits of permissible physiological fluctuations.

For Igor' Volk, who made his first space flight, the period of adaptation took place rather successfully. His good training for this flight and extensive experience with flight work had something to do with this. The cosmonaut-researcher conducted a number of studies of effects of space flight on the visual analyzer (condition of visual acuity, threshold of color sensitivity), working fitness and the biomechanics of movements.

Svetlana Savitskaya's second space flight and the egress of a woman into open space undoubtedly will provide space medicine with much material for understanding mechanisms of space flight's effects on the female organism.

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CSO: 1866/197

## SPACE SCIENCES

### THE 'RELIKT' EXPERIMENT

Moscow ZEMLYA I VSELENNAYA in Russian No 4, Jul-Aug 84 pp 5-12

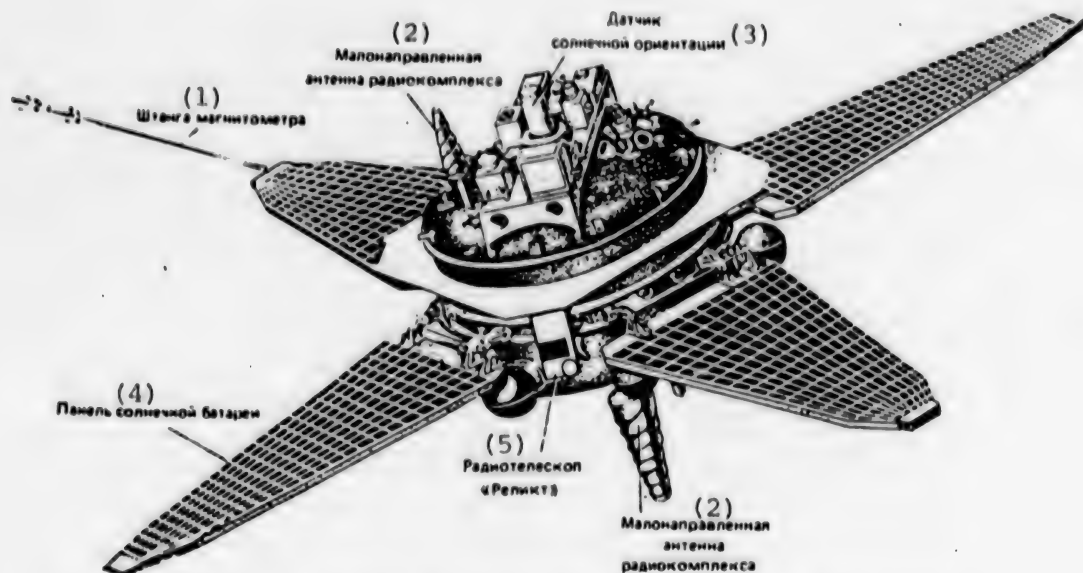
[Article by I.A. Strukov, candidate of physical and mathematical sciences]

[Text] The smallest radio telescope in the world has now been in operation in near space for more than a year. It is carried by the high-apogee "Prognoz-9" satellite and it uninterruptedly receives microwave background radiation on a wavelength of 8 mm. This radiation comes to use from the Universe's remote past.

### A Window Into the Universe's Past

As is known, cosmic microwave background radiation was discovered in 1965 by the American radio astronomers A. Penzias and M. Wilson (ZEMLYA I VSELENNAYA, No 6, 1979, p 45). According to the theory of the hot Universe, at beginning of its expansion the matter and radiation in our Universe were extraordinarily dense and hot (ZEMLYA I VSELENNAYA, No 3, 1969, p 5). During the process of expansion the Universe went through different stages, including a radiation stage, when radiation was the Universe's dominant component and was in thermal equilibrium with the matter. During that period the Universe was opaque as far as electromagnetic radiation was concerned. As expansion continued, the Universe's temperature and density decreased. When the temperature had fallen below 4,000 K, the matter separated from the radiation. After being torn away from the matter, the radiation still continued to expand independently of it. This is the cosmic background radiation (it is also called "relict" or "primary") that Penzias and Wilson registered on a wavelength of 7.35 cm. A year before this discovery, the Soviet cosmologists A.G. Doroshkevich and I.D. Novikov turned their attention to the possibility of observing primary radiation in that same centimeter band of wavelengths.

The separation of matter from radiation takes place because of the recombination of hydrogen, which is formed by the union of free electrons with protons. As follows from the calculations of Ya.B. Zel'dovich and R.A. Syunyayev, recombination takes place very rapidly with a red shift of 1,055, when the Universe's age did not exceed 1 million years, and the course of this process is practically independent of the density of matter in the Universe. Fixed electrons scatter photons considerably more weakly, so the interaction of radiation with



Layout of radio telescope on "Prognoz-9" satellite.

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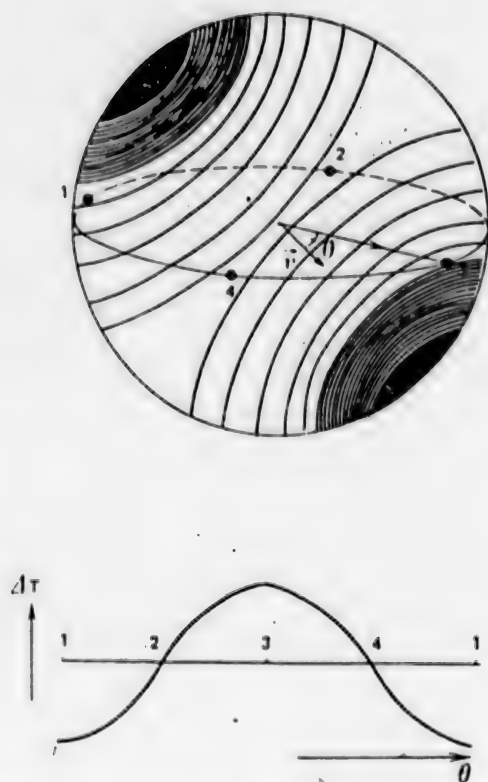
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|---------------------------------------------|-----------------------------|
| 1. Magnetometer boom                        | 3. Solar orientation sensor |
| 2. Low-directional antenna of radio complex | 4. Solar battery panel      |
|                                             | 5. "Relikt" radio telescope |

matter is halted. Throughout the entire time of expansion, the radiation's spectrum corresponds to that of an absolutely black body, but its temperature decreases gradually. Right now it is  $2.9 \pm 0.03$  K.

Before the recombination era, in those places where the matter's density exceeded the average (even if only by negligible percentage), the radiation's temperature also exceeded the average. The recombination of hydrogen revealed all these irregularities. Thus, the state of matter in the era of cessation of recombination was reliably imprinted in the angular distribution of the intensity of the background radiation. By measuring the distribution of this radiation in the celestial sphere, we can more or less look into the Universe's remote past and "see" its radio image when it was 1 million years old.

It should be mentioned that background radiation makes it possible to look into the Universe's past farther than observation of any other known object in the Universe, and to see the initial disturbances in the distribution matter, the growth of which led to the formation of galaxies and clusters and superclusters. These initial disturbances must leave their own tracks in the angular distribution of the background radiation's intensity.

The theories developed by the Soviet cosmologists Ya.B. Zel'dovich, R.A. Syunyayev, A.G. Doroshkevich and I.D. Novikov, along with some foreign scientists--G. Silk, P. Piblis and M. Wilson--predict spatial irregularity (anisotropy) of the microwave background radiation at the level  $\Delta T/T \sim 10^{-4}$ - $10^{-5}$  (ZEMLYA I VSELENNAYA, No 3, 1969, p 5; No 6, 1982, p 35). The characteristic angular dimensions of the embryonic areas from which the galaxies and clusters of galaxies form are approximately  $10'$ . Therefore, small-scale anisotropy of



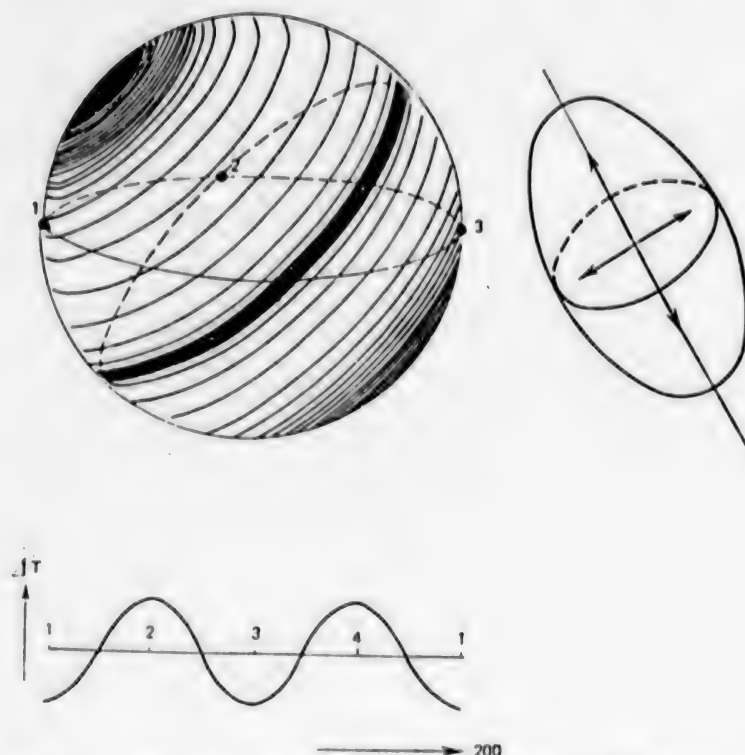
Distribution in the celestial sphere of microwave background radiation, as caused by the Solar System's motion relative to the background.  $\vec{v}$  = velocity vector. The area of increased radiation intensity is shown in red [sic]. Below is the distribution of the background radiation's intensity along a great circle. The sine curve's amplitude is directly proportional to the magnitude of the relative velocity vector's projection on the plane of the circle.

the background radiation was investigated with large antennas having high angular resolution; in particular, the RATAN-600 radio telescope at the USSR Academy of Sciences' Special Astrophysical Observatory was used. However, the 15 years of attempts to detect small-scale anisotropy of the background radiation (by Yu.N. Pariyskiy and B. Partridge) resulted only in an estimate of its upper limit: less than  $10^{-4}$ - $10^{-5}$ . Since these results begin to come in conflict with the main cosmological models, the hypothesis was advanced that during the period of star formation, secondary ionization of the matter took place and the Universe again became opaque to radiation, so the information about the distribution of matter at the moment of primary recombination has been lost.

After the second recombination, anisotropy should also be observed in the distribution of the background radiation, but on a larger angular scale (on the order of  $1$ - $3^\circ$ ). By the way, this angular scale corresponds to the scale of the light horizon during the era of primary recombination. In other words, the distance between two points that are more than  $2^\circ$  apart on the angular scale exceeds 1 million light-years. Let us remember that the age of our Universe by the moment of primary recombination was 1 million years, and light that left one of the points at that time has still not had time to reach the other.

Thus, an investigation of the background radiation's small-scale structure will help us to analyze the dynamics of the development of separate parts and fragments of our Universe. And how did the Universe develop as a whole? Has it always been expanding uniformly? It is possible to answer these questions by studying the distribution of the background radiation's radiobrightness temperature throughout the entire celestial sphere. Besides this, by knowing this distribution it is possible to evaluate the Solar System's direction and velocity relative to the background radiation.

What will an observer who is moving relative to the background radiation see? In the direction of the motion the radiation will undergo a blue shift, and in the opposite direction it will be subjected to a red shift. In other words, in



Distribution in the celestial sphere of intensity of microwave background radiation, as caused by possible anisotropy in the expansion of the Universe. On the right is the ellipsoid of the velocities of expansion of the Universe during the recombination period. Below is the distribution of the background radiation's temperature along a great circle. The sine wave's amplitude is proportional to the magnitude of the difference between the maximum and minimum rates of expansion.

the direction of motion an observer will see a "hot" radiation pole, whereas in the other direction it will be a "cold" one. Such a deviation in the intensity's distribution from strict uniformity is called a "dipole component." The faster the observer is moving, the hotter the radiation pole will be. Therefore, having measured the temperature of the dipole component's poles and having determined their location, it is possible to find the observer's velocity vector relative to the system of reference given by the background radiation.

If the Universe's rate of expansion is not uniform in different directions, different situations are possible. For example, one can observe a separate spot of increased (or decreased) relict radiation intensity, the angular dimensions of which depend on the ratio of the average velocity of matter in the Universe to the critical density, or a weak dipole component, the amplitude of which can be calculated when the uniform expansion changed into a slightly non-uniform one. The possibility that the Universe is expanding at the greatest velocity in some direction or another has not been eliminated. It is then the case that along this axis, two "cold" radiation poles should be seen. This deviation in intensity distribution from uniform distribution is called a "quadrupole component" of the background radiation. Finally, it is possible to see a "spotty" structure in the distribution of the radiation's intensity. In this case, the Universe's radiobrightness pattern will resemble a leopard's skin.



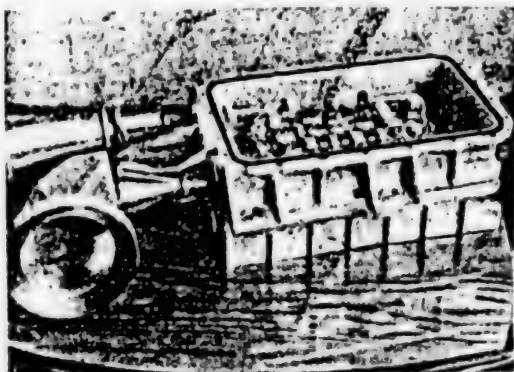
By how much should the temperature of the brightest (coldest) spot differ from the background's average temperature? The theoreticians conjecture that the difference should be  $10^{-4}^{\circ}$ .

At the present time, only a dipole component of the background radiation's anisotropy, caused by the Solar System's motion, has been detected reliably. American and Italian radio astronomers have made observations on wavelengths of 0.9, 1, 1.2 and 1.6 cm (the radio measuring equipment was carried to an altitude of 20 km by balloons and airplanes).

At the end of the 1960's, N.S. Kardashev suggested that the background radiation be observed from artificial satellites in order to reduce the interference that is related to the thermal emissions of the Earth and its atmosphere. Incidentally, such observations have yet another advantage. During 15 years of investigation of the background radiation from high-altitude airplanes and balloons, the American radio astronomers spent no more than 240 h making measurements. In other words, in a year they had less than 24 h of pure observation time. With the same equipment, a satellite experiment lasting 1 year insures almost 100-percent efficiency in time utilization and is equivalent to half a century of ground-based experiments.

The first "Relikt" satellite experiment, during the course of which the background radiation's temperature is measured in the millimeter band (8 mm) was begun on the "Prognoz-9."

How Does One Measure a Thermal Contrast of  $10^{-4}^{\circ}$



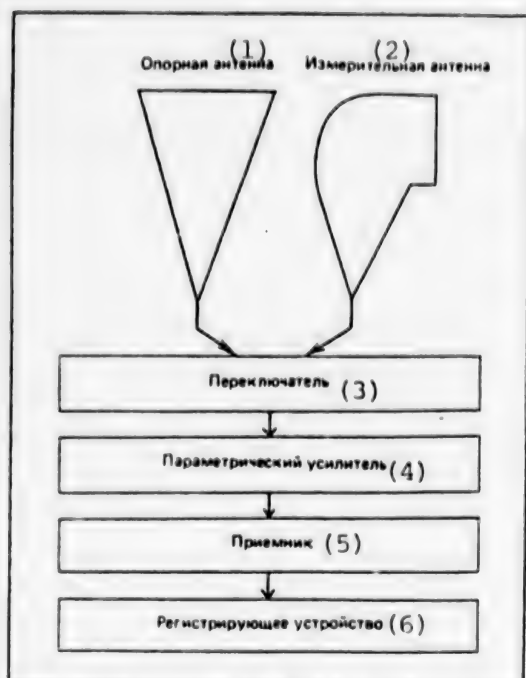
External view of radio telescope for registration of the background radiation's intensity on a wavelength of 8 mm. Weight = 30 kg; power consumption = 50 W.

Let us remember that for a successful investigation of the relict radiation's anisotropy it is necessary to have equipment that can measure a temperature difference of  $10^{-4}^{\circ}$  between two arbitrary sections of the celestial sphere, or a difference in power in a single frequency interval of  $10^{-27}$  W. In order to understand how small this is, let us compare it with the minimum signal power that can be received by an ideal (noise-free) amplifier.

When systematic errors are eliminated, any measuring device's sensitivity is limited by its internal noises. It would seem that if we remove all sources of noise from an amplifier, it would be able to receive the smallest possible signal and we would have a noise-free amplifier. However, such an assumption leads to violation of the indeterminacy principle.

Actually, if a receiving unit has a single frequency band, it will respond to effects that repeat no more frequently than once per second. The minimum





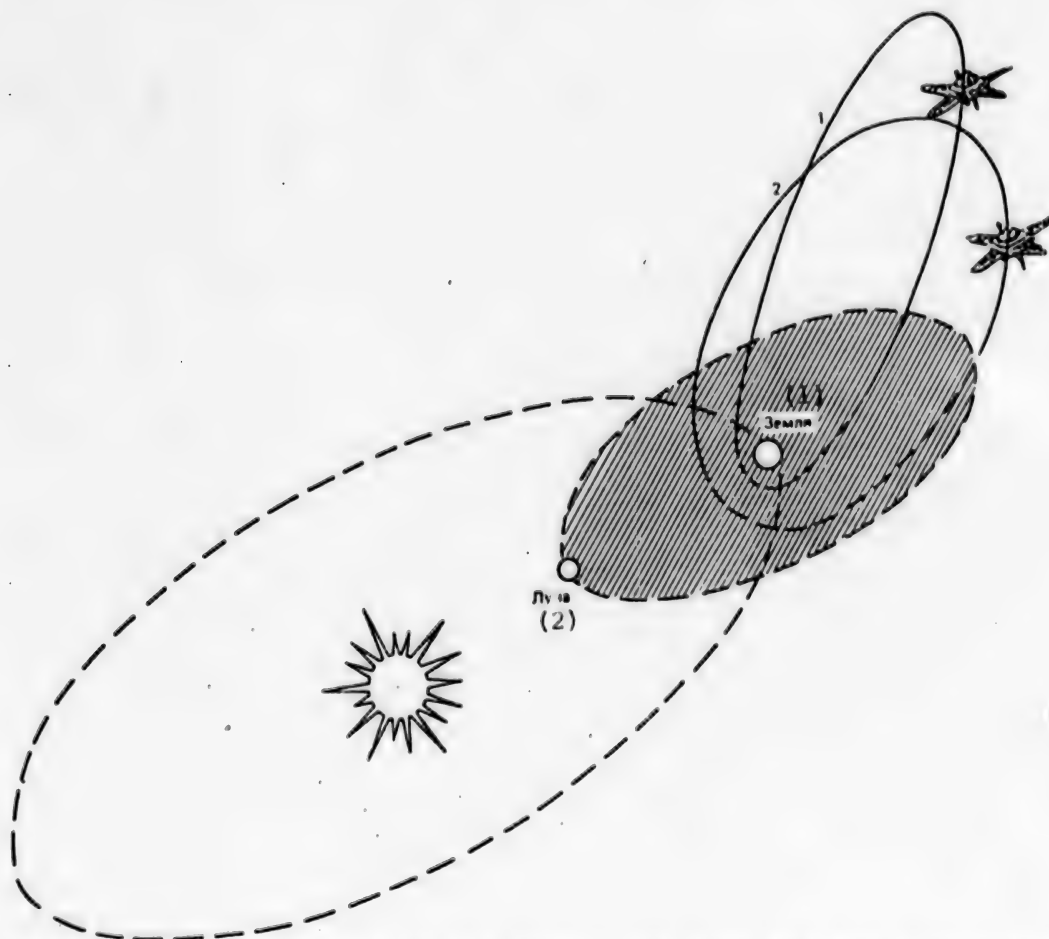
Block diagram of the radio telescope. Signals arriving from the reference and measuring antennas are fed alternately into the amplifier's input. The amplified signal is then fed into the mixing receiver's input. There the input signal, on a frequency of  $37 \pm 0.5$  GHz, is converted into a band of frequencies 50-450 MHz wide, amplified and sent into the registration unit, where information on the difference in the primary signals' intensities is extracted from it.

Key: 1. Reference antenna  
2. Measuring antenna  
3. Commutator  
4. Parametric amplifier  
5. Receiver  
6. Registration unit

amount of energy to which the receiving system reacts equals that of one photon. On a working frequency of 37 GHz, the energy of a photon is  $2.45 \cdot 10^{-23}$  J. Since the receiving unit registers no more than one photon per second, the threshold power is  $2.45 \cdot 10^{-23}$  W (more accurate calculations result in a figure of  $3.5 \cdot 10^{-23}$  W); that is, 4 orders of magnitude greater than the difference power that it is necessary to register. The parametric amplifier used in the "Relikt" experiment quite naturally has more noise power ( $9.6 \cdot 10^{-22}$  W) than an ideal one. So how do we measure such a small difference in powers coming from different directions?

It was completely natural to make use of the fact that all preceding investigators did this by the differential method of measurement; that is, the power received from a given direction is compared to power from a standard source. The standard source must have extraordinarily high stability and be at a temperature of 3 K. A natural source that has these characteristics is the relict radiation itself. If we aim the radio telescope's reference antenna at an arbitrary area of the celestial sphere and maintain this orientation during the observation period, while the measuring antenna is oriented in different directions that are of interest, we will be able to compare the powers of radiation arriving at the reference and measuring antennas. Thus, in principle we can compile a map of the distribution of the relict radiation's intensity in the celestial sphere.

It remains to be explained how to distinguish a signal that is drowned in the equipment's noise. For this we use a method that is utilized extensively in different areas of science. For instance, archeologists investigating old documents photograph them repeatedly in different spectral bands and then superimpose the obtained images on each other. When this is done, details appear that are invisible in any single photograph. The basis of the method is the fact that during addition the "signal-to-noise" ratio increases by a factor of  $\sqrt{N}$ , where  $N$  is the number of measurements.



Relative position of orbits of the Earth, the Moon and the "Prognoz-9" satellite: 1. initial orbit of "Prognoz-9"; 2. orbit 1 year after launching.  
Key: 1. Earth 2. Moon

In the "Relikt" experiment the antenna has an angular resolution of  $6^\circ$  and, consequently, can produce a map that contains about 1,500 elements. If one measurement is made per second, in a year each element is observed for about 3 h, thanks to which the noise level is reduced by a factor of 100, although it is necessary to reduce it by a factor of 1 million. How can this be done? The only way is to increase the number of measurements, for which it is necessary increase the measurement speed. It is a well-known fact that the number of measurements that can be made in 1 s is proportional to the band of frequencies being received. The receiving unit that is part of the radio telescope installed in the "Prognoz-9" has a band of 400 MHz, which makes it possible to make  $4.3 \cdot 10^{12}$  measurements in 3 h of continuous observation. This makes it possible to reduce equipment noise by a factor of 2 million.

During the creation of such a sensitive instrument, it was necessary to overcome rather significant technical difficulties, a list of which would occupy more than a page of text. I will present only the most practical example. Suppose we have to make a contact device consisting of a hole  $3 \mu\text{m}$  in diameter and a small spring. For the spring we use wire that is the thickness of a human hair and 0.5 mm long. This wire spring must be bent into a complex shape, sharpened at one end, and plated with gold. After this the wire's sharpened end must be

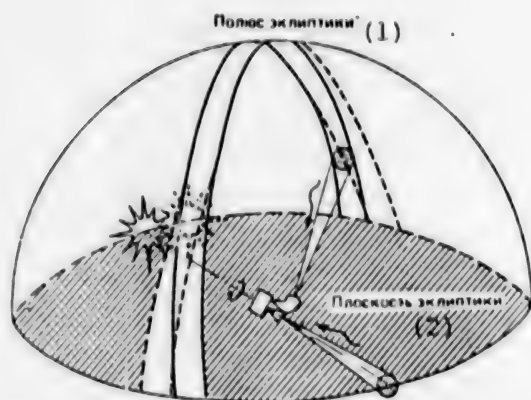


Diagram of coverage of the celestial sphere in the "Relikt" experiment. The radio telescope's reference horn antenna "looks" at a point opposite the Sun, while the parabolic-horn measuring antenna traces a circle in the celestial sphere because of the rotation of the satellite around its axis. The dash line indicates the primary viewing circle; the solid line indicates the viewing circle after reorientation of the satellite.

Key: 1. Ecliptic pole  
2. Ecliptic plane

placed in the hole so as to form an electrical contact that makes it possible to pass an electric current through it  $4 \cdot 10^{10}$  times per second. The current's density ( $10^9$  A/m<sup>2</sup>) is several times that of the current in a bolt of lightning. In connection with this, the contact must function reliably for several years and its properties must not change when the satellite is being put into orbit.

In order to create such a unique instrument it is necessary to be a blacksmith and a lightning tamer at the same time; know how to excite electromagnetic oscillations of a complex shape on a wavelength of several millimeters; learn how to design antennas, the emissions of which will be suppressed by a factor of hundreds of millions in the plane perpendicular to the direction axis, and much, much more. Of course, the solution of all the problems that arose was beyond the capabilities of one person. Success was achieved only because of the selfless labor of workers at the USSR Academy of Sciences' Institute of Space

Research and that institute's Special Design Office, as well as a number of industrial enterprises. Nevertheless, the experimental difficulties were not limited merely to the creation of unique equipment.

The desire to avoid or weaken the effect of the Earth's and Moon's thermal emissions required that the satellite be as far from them as possible. In orbits with an apogee of more than 1 million km, the Sun's attraction begins to be felt, and substantial variation in a satellite's launch velocity makes it probably that it will be captured by the Sun. Therefore, an orbit with an apogee of 700,000 km and a perigee of 1,000 km was selected for the "Prognoz-9."

At first the points where the satellite intersected the plane of the Moon's orbit lay inside this orbit and the Moon was far from the satellite at the moment when the latter intersected the plane. In time the satellite's orbit "inflated," and one of the points of intersection approached the lunar orbit. The discrepancy between the periods of revolution of the Moon and the satellite can lead, in time, to their coming together the satellite's colliding with the Moon. The possibility of the existence of such an orbit for a period of a year was first demonstrated in 1979 by the Soviet ballistic specialists P.Ye. El'yasberg, N.A. Eysmont and A.I. Sheykhed.

In the Orbit of the "Prognoz-9"

But now all the difficulties are behind. Launch day has arrived. On the night of 1-2 July 1983, we await the first communication session nervously. Information arrives from the satellite: a uniform noise track, with the signal drowned in the equipment noise, and able to be distinguished only after extended processing. However, we became confident that the equipment was operating normally. Regular observations were begun.

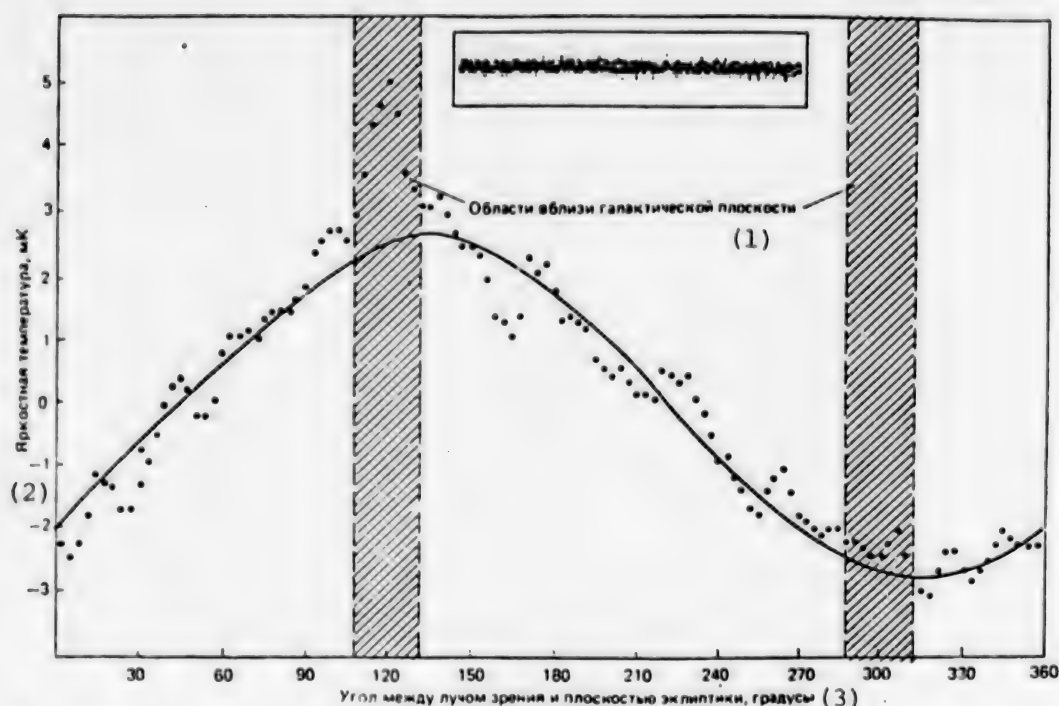
"Prognoz-9" revolves every 2 min around an axis that is aimed at the Sun. The radio telescope's reference antenna is oriented along the satellite's axis of rotation at a point opposite the Sun and receives radiation from the same direction at all times. The radio telescope's measuring antenna "looks" in a direction that is perpendicular to the axis of rotation, and during a complete revolution of the satellite around its axis views a large circle in the celestial sphere that is  $6^\circ$  wide. In connection with this, each element is observed for 2 s. The reference and measuring antennas are connected alternately, on a frequency of 1 kHz, to the amplifier's input, and at the receiving unit's output there appears an amplified signal that is proportional to the difference in the radiobrightness temperatures of the radiation received by the antennas. This is the way the radio image of a circle of the celestial sphere is built up. The same ring is observed for 7 days. As a result, there are  $2 \cdot 10^{12}$  measurements of each element in the ring. The experimental data are recorded by a memory unit on board the "Prognoz-9." Once every 4 days, the information is transmitted to Earth over the communication links.

Once every 7 days, upon receiving a command from Earth, reorientation of the satellite's axis of rotation takes place (because of the daily motion of the Earth around the Sun, the satellite's axis of rotation is displaced relative to the direction to the Sun by about  $1^\circ$  per day) so that it is again directed at the Sun, and the next ring--shifted relative to the preceding one by  $7^\circ$ --in the celestial sphere is observed. By reorienting the satellite periodically, the entire celestial sphere can be viewed in half a year.

Despite the severe elongation of the satellite's orbit, in separate areas of the celestial sphere it is possible to observe "flashes," caused by the emissions of the Earth and the Moon, that get into the receiving system. In order to reduce the effect of the Moon's, Earth's and Sun's thermal emissions, the radio telescope's antennas have finned surfaces. Thanks to this, it was possible to reduce by several orders of magnitude the level of the signal received from the lateral directions, but the possibility of this radiation's striking the antennas has still not been completely eliminated.

The observations that have been made make it possible to formulate some preliminary opinions about how our galaxy is moving in space. It is moving, at a speed of about 515 km/s, in the direction of the nearest galaxy cluster in the constellation Virgo, but not precisely at the cluster. The angle between the velocity vector and the direction to the cluster is about  $50^\circ$ . If our galaxy's perpendicular velocity is caused by a supercluster, its value can be used to evaluate the ratio of the average density of matter to the critical value in the vicinity of 70 Mpc (megaparsecs). Estimates result in a value of 0.1-0.2. From this, however, one cannot draw the conclusion that our Universe is open and expanding infinitely. Data on the density of matter in a





Signal caused by the Solar System's motion relative to relict radiation, as obtained after processing of information gathered by "Prognoz-9," from 7 to 13 July. The sine wave's amplitude is determined by the rate of motion. In the inset is a recording of the information received by the radio telescope that has not undergone processing. The sinusoidal signal is not seen because it is "buried" under the equipment noise.

Key: 1. Areas close to the galactic plane 3. Angle between viewing angle and ecliptic plane, degrees  
2. Brightness temperature, mK

relatively small volume of space cannot be extrapolated for the Universe as a whole.

The Milky Way area shines amazingly brightly on the 8-mm wavelength, and this creates additional difficulties in the investigation of the relict background's anisotropy. Radiation observed in a rather broad  $60^\circ$  equatorial belt in our galaxy carries extremely valuable information about the distribution of the hot galactic plasma. Shells of hot plasma around the nearest galaxies and galaxy clusters may possible be detected in the future.

In areas where the effect of our galaxy's emissions is small, anisotropy of the relict background was not detected even at the  $2 \cdot 10^{-4}$  K level. Processing of all the information that has been received will make it possible to lower this limit by yet another order of magnitude, or detect deviations in the distribution of the radiation's intensity. For a final conclusion about the presence of anisotropy, however, it will be necessary to make measurements on other and higher frequencies in order to determine the radiation source's spectral index.

At the same time, the main achievement of the "Relikt" experiment is the flawless functioning of the unique radio telescope, the characteristics of which

are better than those of any of its foreign analogs. There are hopes that in the very near future, the size of the minimally detectable signal will be reduced by a factor of three. The "Relikt" space experiment will then produce information about a number of cosmological peculiarities in the Universe that are encoded in relict radiation anisotropy, about the distribution of clusters and superclusters of galaxies in the celestial sphere, and--possibly--about new cosmic radio sources in the short-wave band.

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CSO: 1866/177



## ASTROMETRY RESEARCH AT PULKOVO OBSERVATORY

Leningrad VECERNIY LENINGRAD in Russian 30 May 84 p 3

[Article by G. Oshin]

[Excerpt] Studies in line with a broad scientific program are in progress at the USSR Academy of Sciences' Main Astronomical Observatory in Pulkovo. The creation of a unified system of celestial coordinates is one of the most important directions of this work.

Methods for determining coordinates are developed by the branch of astronomy known as astrometry. Its most eminent representatives in Pulkovo are M. S. Zverev, corresponding member of the USSR Academy of Sciences, and professors A. A. Nemiro, A. N. Deych and N. N. Pavlov.

The Pulkovo astrometrists' basic research accomplishments include the preparation of a Catalog of Positions of Weak Stars.

The Nikolayev branch of the observatory undertook an interesting expedition to Spitsbergen Island. More than 15,000 observations were made there during the polar night. Unique results of measurements which are free of seasonal and daily errors were obtained over a period of three years.

The Pulkovo astronomers are also observing the sky of the Southern Hemisphere. Through an agreement with the Bolivian Academy of Sciences, they have been working at a station at a high elevation in the Andes Mountains for two years.

(Two photographs are given showing Yu. S. Streletskiy, head of a group; and N. V. Yudina and E. V. Kondrashov, associates of the observatory's department of solar physics, working with a horizontal solar telescope.)

FTD/SNAP

CSO: 1866/197

#### IMPROVEMENTS MADE ON RATAN-600 TELESCOPE

Moscow IZVESTIYA 29 Jun 84 p 1

[Excerpt] RATAN-600, the world's largest reflecting radio telescope with a diameter of about 600 meters, enables scientists to scan the farthest recesses of the heavens. For example, 'ripples' on the Sun's surface were detected in the centimeter wave range for the first time in the history of radio astronomy by means of this telescope. This is very important for predicting solar activity. The radio telescope has made it possible to find and study the gigantic remains of supernova explosions.

The radio telescope's capabilities are continuously increasing. New-generation receiving and measuring devices are being installed. They will increase the radio telescope's sensitivity by a factor of ten.

(Photographs are given showing corresponding member of the USSR Academy of Sciences Yu. Pariyskiy, scientific director of work on the telescope, and G. Golubchin, O. Shivris and A. Berlin, chief designers of the telescope's systems; and a secondary mirror that is being installed on the telescope, which will considerably enhance its power.)

FTD/SNAP

CSO: 1866/197

ASSOCIATES RECALL ROCKETRY PIONEER A. A. BLAGONRAVOV

Moscow SOVETSKAYA ROSSIYA in Russian 1 Jun 84 p 4

[Article by Aleksandr Nemov]

[Abstract] A full page of articles is published marking the 90th anniversary of the birth of academician Anatoliy Arkad'yevich Blagonravov, who headed the USSR Academy of Sciences' Institute of Machine Science for more than 20 years. A preface by K. V. Frolov, corresponding member of the USSR Academy of Sciences and the present director of this institute, mentions some of Blagonravov's contributions to the designing and development of automatic weapons and space technology. It is recalled that he took part in the launching in 1951 of the USSR's first special vertical-launch rocket with research instruments and two animals on board.

The main article records recollections of Blagonravov by six persons who worked for him at the institute. Among them are doctors of technical sciences Ye. Gerts, A. Bessonov, V. Lyuttsau, A. Chichinadze and S. Dobrynin.

FTD/SNAP

CSO: 1866/197

UDC: 629.7

PERIODIC OSCILLATION OF GYROSTAT-SATELLITE ABOUT ITS CENTER OF MASS IN AN ELLIPTICAL ORBIT

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 22, No 2, Mar-Apr 84  
(manuscript received 20 Jul 82) pp 147-158

SAZONOV, V. V.

[Abstract] A gyrostat-satellite is a solid containing a symmetrical rotor. The axis of rotation of the rotor coincides with the axis of symmetry and is rigidly coupled to the solid body. The angular speed of the rotor relative to the body is constant. It is assumed that the center of mass of the satellite moves in a Kepler elliptical orbit and the axis of rotation of the rotor is parallel to one of the main central axes of inertia of the satellite. The motion of the system is described by a system of ordinary 6th order differential equations with periodic coefficients. The results of numerical studies of the boundary-value problem are presented. Solutions are constructed as formal series with respect to negative powers of a large parameter and numerically studied. Figures 6; references 10: 9 Russian, 1 Western.

[130-6508]

UDC: 629.782

PLANNING OF NAVIGATION MEASUREMENTS USING TD CRITERION FOR DETERMINATION OF MOVEMENT OF SPACECRAFT BY METHOD OF LEAST SQUARES

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 22, No 2, Mar-Apr 84  
(manuscript received 31 May 83) pp 159-164

NEVOL'KO, M. P., DROBIN, I. S. and BELOUSOV, L. Yu.

[Abstract] Disagreement between planned and measured results has stimulated a new trend in the theory of processing of trajectory measurements involving the apparatus of multipurpose planning of navigational

measurements to predict spacecraft motions in near-circular orbits by least-squares-method processing. The problem of selecting the optimal composition of measurements to achieve minimal variation between full and reduced sample calculations is studied. It is found that processing of relatively large numbers of measurements of motion parameters by the method of least squares does not always result in an increase in accuracy of prediction of spacecraft motion. The use of various methods of decreasing redundancy of measurements with no reliable data on correlation of measurement errors does not reduce accuracy of prediction of motion. Figures 6; references 10 (Russian).  
[130-6508]

UDC: 629.197.2

#### NONLINEAR OSCILLATIONS OF TWO BODY SYSTEM RELATIVE TO CENTER OF MASS IN ELLIPTICAL ORBIT

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 22, No 2, Mar-Apr 84  
(manuscript received 4 May 82) pp 165-170

GULYAYEV, V. I., LIZUNOV, P. P., and PRUDENKO, N. N.

[Abstract] A study is made of a system of two bodies connected by elastic couplings. The center of mass moves in a gravitational field in an elliptical Kepler orbit. The method of continuing a solution with respect to a parameter is used to construct a periodic solution to the nonlinear differential equations of motion of the system. The influence of the attached mass of the system and relationships between main central moments of inertia on stability and form of relative motion are studied. It is found that a change in inertial parameters of the system has a significant influence on the stability and form of oscillations. Increasing attached mass leads to destabilization of the motion of the system in most cases. Figures 4; references 5 (Russian).  
[130-6508]

RAPID NONRESONANT ROTATION OF A SPACECRAFT IN NOMINALLY PERIODIC ORBITS  
IN LIMITED THREE BODY PROBLEM

Moscow KOSMICESKIYE ISSLEDOVANIYA in Russian Vol 22, No 2, Mar-Apr 84  
(manuscript received 28 Oct 82) pp 171-180

KRASIL'NIKOV, P. S.

[Abstract] A study was made of rapid nonresonant rotations of a satellite in an arbitrary nominally periodic orbit in the elliptical limited three body problem based on partial averaging of the Hamiltonian of the system. Gravitational moments cause evolution of kinetic energy of the undisturbed relative motion of the satellite. The relative motion is studied by analyzing the generalized elliptical problem of three bodies, two of which are bodies with spherical distribution of mass moving relative to each other in an elliptical Kepler orbit, while the third is a satellite of negligible mass with an arbitrary ellipsoid of inertia. The equations derived describe the rotation of a spacecraft in any nominally periodic trajectories of its center of mass computed with any degree of accuracy considering arbitrary perturbing forces. Figures 6; references 13 (Russian).  
[130-6508]

UDC: 550.385.41

## USE OF GRAVITATIONAL STABILIZATION IN PERFORMANCE OF EXPERIMENTS

Moscow KOSMICESKIYE ISSLEDOVANIYA in Russian Vol 22, No 2, Mar-Apr 84  
(manuscript received 29 Mar 82) pp 181-188

BELYAYEV, M. Yu. and TYAN, T. N.

[Abstract] Spacecraft such as the "Salyut-6" use gravitational stabilization for the conduct of geophysical, astronomical and other experiments. Development of an effective strategy for controlling spacecraft in gravitational stabilization modes requires studying the specifics of motion of the spacecraft. In this work, the gravitational orientation of the station is studied both with a mathematical model of motion considering the effect of gravitational, aerodynamic and magnetic disturbances, and using actual telemetry information from the control system of the angular position installed on the spacecraft. This approach allows the true picture of motion of the spacecraft to be established and practical recommendations to be developed for using gravitational stabilization in performing scientific experiments. Figures 4; references 11 (Russian).  
[130-6508]



## CONTROL OF LATERAL TRAJECTORY MOTION OF SPACECRAFT IN ATMOSPHERE

Moscow KOSMICESKIYE ISSLEDOVANIYA in Russian Vol 22, No 2, Mar-Apr 84  
(manuscript received 15 Oct 82) pp 189-200

DUDAR, E. N. and YAROSHEVSKIY, V. A.

[Abstract] The equation of motion of a spacecraft in the atmosphere has a peculiarity in that the time characteristic for the motion of the spacecraft about its center of mass is usually significantly less than the time characteristic for the trajectory motion. In many cases, problems of optimal control of spacecraft trajectories are therefore solved without considering its motion about its center of mass. This article studies one such problem, the problem of control of the spatial trajectory of a spacecraft by changing the bank angle. The control vector is included linearly in the right portion of the trajectory equations of motion, which can be linearized and applied to the apparatus of the theory of stochastically optimal control systems. A control algorithm is suggested based on construction of areas of permissibility in the space of final parameters. Numerical examples are included. Figures 11; references 4: 2 Russian, 2 Western.  
[130-6508]

UDC: 629.7

## CONVECTION OF PLASMA IN POLAR IONOSPHERE, COMPARISON OF MEASUREMENTS FROM 'COSMOS-184' WITH MODEL DEPENDENT ON INTERPLANETARY MAGNETIC FIELD VECTOR

Moscow KOSMICESKIYE ISSLEDOVANIYA in Russian Vol 22, No 2, Mar-Apr 84  
(manuscript received 18 Jan 83) pp 201-212

BELOV, B. A., GAL'PERIN, Yu. I., ZININ, L. V., LEVITIN, A. Ye.,  
AFONINA, R. G. and FEL'DSHTEYN, Ya. I.

[Abstract] One of the most difficult problems arising in the construction of a polar cap plasma model is determination of the "average" quasisteady picture of the electric field, convection and longitudinal currents, which are determined by factors external to the magnetosphere such as the interplanetary magnetic field, velocity and pressure of the solar wind, level of solar UV radiation, date and time. Satellite measurements can be used to study the variations. A combination of various geophysical measurement methods has revealed certain characteristic structural elements of the unsteady field and current picture during substorms. The work uses the simplest available model, constructed on the basis of correlation analysis of variations in the geomagnetic field with parameters of the solar wind. Elimination of a number of simplifying assumptions would greatly increase the complexity and difficulty of using the model. Figures 6; references 72: 12 Russian, 60 Western.  
[130-6508]

# EQUATORIAL ENERGETIC DISTRIBUTIONS OF IONS OF TERRESTRIAL RADIATION BELT AS FUNCTION OF SOLAR CORONA TEMPERATURE RESPONSE

Moscow KOSMICESKIYE ISSLEDOVANIYA in Russian Vol 22, No 2, Mar-Apr 84  
(manuscript received 11 May 82) pp 213-224

VLASOVA, N. A. and PANASYUK, M. I.

[Abstract] The energy spectra of ions with energy over 1 MeV are studied in the radiation belts near the geomagnetic equator during a magnetically quiet period. Good agreement between experimental and calculated data in the energy range over 1 MeV is achieved for helium, oxygen and carbon in relative concentrations typical for the solar wind. Spectral data for several types of ions within a geostationary orbit are compared in order to analyze experimental spectral measurements of H and He ions made onboard the "Molniya-1" and "Molniya-2" satellites, He, C and O ions onboard the ISEE-1 satellite and H and He onboard the Explorer-45 satellite. In the outer L envelopes energetic H, He, C and O ions have spectra which are similar in the E/Q presentation, where Q presents the charge status of the ions characteristic for charge equilibrium in the corona at temperatures of  $1-2 \cdot 10^6$  K. The dominant fluxes of energetic ions within the radiation belts can be explained by assuming the effect of the magnetospheric mechanism of acceleration forming the distribution function of the ions similar to the E/Q presentation. Figures 3; references 45: 12 Russian, 33 Western.  
[130-6508]

UDC: 523.035:525.72

# HELIUM ATOMS IN INTERSTELLAR AND INTERPLANETARY MEDIA, PART 3: TEMPERATURE AND VELOCITY OF INTERSTELLAR WIND

Moscow KOSMICESKIYE ISSLEDOVANIYA in Russian Vol 22, No 2, Mar-Apr 84  
(manuscript received 12 Sep 83) pp 225-237

KURT, V. G., MIRONOVA, Ye. N., BERTO, Zh.-L. and DALOD'E, F.

[Abstract] The distribution of intensities over the celestial sphere in the neutral helium line at  $\lambda=584$  A obtained by background radiation observations on the "Prognoz-6" satellite with a 4-channel photometer was used to find the temperature and magnitude of the velocity vector of the interstellar wind. The direction of motion of the interstellar medium relative to the sun was preliminarily determined from the same observations. Interaction of neutral helium in the interstellar medium with the gravitational field of the sun and resonant scattering on interplanetary helium are calculated. The temperature and velocity of the model best agreeing with the observed results was determined separately for each of 6 measurement sessions

onboard the satellite. The average temperature was 11,600 K, velocity 25.3 km/s. The mean density of helium in space near the sun was found to be  $0.018 \text{ cm}^{-3}$ . Figures 5; references 17: 5 Russian, 12 Western.  
[130-6508]

UDC: 550.388.2

BEHAVIOR OF CHARGED PARTICLES IN LOWER IONOSPHERE WITH ACOUSTICAL EFFECTS

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 22, No 2, Mar-Apr 84  
(manuscript received 20 May 83) pp 238-242

DEVYATERIKOV, I. A., IVANOV, Ye. A., KOZLOV, S. I. and KUDRYAVTSEV, V. P.

[Abstract] A study was made of the behavior of charged particles in the D layer of the ionosphere between 50 and 90 km altitude when acoustical effects occur as a result of earthquakes, industrial explosions, entry of meteorites into the atmosphere, etc. Particular attention is given to the photochemical aspects of the problem. It is found that photochemical equilibrium can be disrupted by weak shock and acoustical waves in the lower portion of the D layer. Figures 2; references 11: 7 Russian, 4 Western.  
[130-6508]

UDC: 550.81:523.3

PHYSICAL AND MECHANICAL PROPERTIES OF LUNAR SOIL AS FUNCTION OF SPECIFICS OF RELIEF AND PROCESSES IN VICINITY OF OPERATION OF 'LUNOKHOD-2'

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 22, No 2, Mar-Apr 84  
(manuscript received 17 Dec 82) pp 243-251

BAZILEVSKIY, A. T., GREBENNIK, N. N., GROMOV, V. V., DMITRIYEV, A. D., KEMURDZHIAN, A. L., POLOSUKHIN, V. P., SEMENOV, P. S. and FLORENSKIY, K. P., (deceased)

[Abstract] "Lunokhod-2" performed investigations in the southern portion of Lemonier crater, investigating the bottom of the crater, a fault on the crater bottom and the hilly broken continental terrain to the south of the crater floor. The studies showed that the physical and mechanical properties of the lunar regolith varied with slope steepness, duration of exposure and local peculiarities of relief. Photographs taken by "Lunokhod-2" and lunar orbiter IV are presented. Although there is significant variation in load-bearing capacity of the lunar soil, as the steepness of the surface increases the load-bearing capacity generally smoothly decreases. The longer deposits on the surface are exposed, the stronger the deposits become, all

other factors being equal. The slope process of temperature creep is very important in the formation of the peculiarities of the regolith and evolution of relief. Figures 4; references 17: 16 Russian, 1 Western.  
[130-6508]

UDC: 551.52;551.57

#### MODEL OF ATMOSPHERIC OZONE FOR MIDDLE LATITUDES

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 22, No 2, Mar-Apr 84  
(manuscript received 27 Sep 82) pp 306-309

KOMAROV, V. S. and MITSEL', A. A.

[Abstract] An attempt is made to utilize observational data of recent years to generate a reliable model of the high altitude distribution of ozone. The model is constructed on the basis of a single method and the data of representative samples of ozonometric high altitude observations and contains the mean profiles of atmospheric ozone plus parameters of its variation with space and time. Profiles are presented for both summer and winter. The middle-latitude model is compared with the Krueger model prepared for the USA 1976 standard atmosphere. Figures 2; references 10: 4 Russian, 6 Western.  
[130-6508]

#### LOW-ENERGY C, N, AND O NUCLEUS FLUXES IN ORBIT OF 'SALYUT-6'

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 22, No 2, Mar-Apr 84  
(manuscript received 21 Feb 83) pp 310-312

BOBROVSKAYA, V. V., GORCHAKOV, Ye. V., GRIGOROV, N. L., MARIN, A., NYTMIK, R. A., KHAYDUK, M., KHASHEGAN, O. and TRET'YAKOVA, Ch. A.

[Abstract] A dielectric track detector was exposed in open space by the "Salyut-6" Soviet-Rumanian crew 16-21 May 1981. The experiment was intended to record nuclei with energies of 5 to 50 MeV per nucleon. After exposure for 111 hours the detector was developed, yielding data with sufficient statistical accuracy to produce preliminary conclusions concerning the energy spectra and charge composition of nuclei. Data were compared with measurements performed in 1973-1974 aboard the Skylab. In the range of energies over 15 MeV/nucleon the spectra measured by both spacecraft were similar. At less than 15 MeV/nucleon the data diverge. Figures 3; references 5: 1 Russian, 4 Western.  
[130-6508]

VARIATION OF FAST CHARGED PARTICLES IN EVENT OF 22 NOVEMBER 1977 BASED ON  
'COSMOS-900' SATELLITE DATA

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 22, No 2, Mar-Apr 84  
(manuscript received 28 Feb 83) pp 312-315

GORCHAKOV, Ye. V., IOZENAS, V. A., TERNOVSKAYA, M. V., AFANAS'YEV, V. G.,  
AFANAS'YEV, K. G. and IGNAT'YEV, P. P.

[Abstract] The "Cosmos-900" satellite launched 30 Mar 77 into a near circular orbit with an altitude of 500 km, inclination 83°, studied cosmic rays by means of a Cherenkov counter which recorded heavy particles with a charge of over 1 and energy of over 400 MeV/nucleon plus electrons with energies of over 15 MeV. A solar flare occurred on 22 Nov 77, beginning at 0945 and reaching its maximum at 1007 UT. The data obtained can be used to estimate the form of the energy spectrum of the radiation recorded in the energy range from 400 to 2000 MeV. Sharp counting peaks were observed at 1035 and 1140 UT. Neutron monitors do not show these sharp increases. It is possible that the maxima result from specifics of penetration of solar cosmic rays into the magnetosphere and albedo particles arising as these cosmic rays act upon the atmosphere. Figures 1; references 8: 3 Russian, 5 Western.  
[130-6508]

PRECIPITATION OF PROTONS WITH  $E_p \sim 1$  MeV NEAR PLASMOPAUSE

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 22, No 2, Mar-Apr 84  
(manuscript received 9 Feb 83) pp 315-318

VAKULOV, P. V., YEMEL'YANENKO, S. N., KUZNETSOVA, V. A., KUZNETSOV, S. N.,  
KUDELA, K. and POPELYAVSKA, B.

[Abstract] Data obtained by the "Intercosmos-5" satellite revealed fluxes of quasicaptured protons at  $L \sim 3.2$  during geomagnetic disturbances. It is assumed that the quasicaptured protons result from the interaction of captured protons with hydromagnetic waves. The Fermi mechanism of interaction of waves and particles is found to influence the dynamics of captured protons in the vicinity of the plasmopause where there is a well-expressed trough in the distribution of the cold plasma. Apparently these conditions occurred during magnetic disturbances. A full experiment to check the effectiveness of this scattering mechanism must include measurements of the flux and spectrum of protons plus measurements of cold plasma density and the amplitude of Alfvén waves with a period of 3 to 10 seconds. Figures 3; references 9: 5 Russian, 4 Western.  
[130-6508]



FAST HARTMANN METHOD FOR PROBLEMS IN ASTRONOMICAL ADAPTIVE OPTICS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 274, No 5, Feb 84  
(manuscript received 18 Nov 83) pp 1057-1060

BALAKHOVSKAYA, T. I., BORISENKO, V. I., VITRICHENKO, E. A.,  
MASLENNIKOV, K. L., PROKHOROV, A. M. (academician), SAGDEYEV, R. Z.  
(academician), TRUSHIN, Ye. V., and CHESALIN, L. S., Institute of Space  
Research, USSR Academy of Sciences, Moscow

[Abstract] New equipment for doing fast Hartmann tests on adaptive optical telescopes is described. The apparatus, designated "SVIT", is a stand-alone video data terminal developed jointly by the Institute of Space Research and the Kirov Polytechnical Institute, to be used as part of the "SIG" automatic television chain. "SVIT" is a unit designed for digital interactive processing of video data, and can be used in a broad range of applications. "SIG" and "SVIT" are designed for use with the "GRIFON" automatic atmospheric distortion recorder. Operation of the complete system is described and it is shown that productivity is more than 100 times better than manual measurements and more than 10 times better than scanning microphotometers. A series of observations conducted using the "GRIFON" system at the Ukrainian Academy of Sciences Main Astronomical Observatory in Kiev is described. Theoretical considerations are discussed and it is shown that Kolmogorov-Obukhov "rule of 2/3" to which atmospheric phase fluctuation is subject, and the contribution made by operating mode to given fluctuation can be determined empirically. An examination of temporal behavior in the various components of fluctuation showed that for some kinds of deformation, fluctuation frequency is quite low, which enables less stringent requirements for adaptation rate. The findings make it possible to clarify the requirements for the elements in an adaptive system and indicate new possibilities in studying atmospheric astroclimatic characteristics. Figures 4; references 7: 4 Russian, 3 Western.  
[132-9642]

UDC: 523.982.8

STATISTICAL ANALYSIS OF 11-YEAR AND 80-YEAR SOLAR CYCLES

Moscow ASTRONOMICHSKIY ZHURNAL in Russian Vol 61, No 1, Jan-Feb 84  
(manuscript received 22 Dec 82) pp 163-169

BIYELEKOVA, M., Geophysics Institute, Slova Academy of Sciences, CSSR,  
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[Abstract] The method of linear two-parameter regression analysis was used to process the 11-year and secular (Gleissberg) solar cycles using Wolf numbers. The 11-year cycle is a cosine curve as a rough approximation,



since the cycle rises more rapidly than it drops and sometimes has two maxima. The correlation of Wolf numbers with a cosine curve is rather high. Results of approximation of 11-year solar cycles by generalized analysis were used as the initial material for determination of the secular cycle. Three maxima have been observed, in 1778, 1860 and 1950. Two methods were used to determine the parameters of this cycle. The 80-year cycle was statistically confirmed. Figures 4; references 13: 6 Russian, 7 Western. [115-6508]

UDC: 521.6

#### MIXED SECULAR PERTURBATIONS OF SATELLITE ORBITS

Moscow ASTRONOMICHESKIY ZHURNAL in Russian Vol 61, No 1, Jan-Feb 84  
(manuscript received 26 Nov 82) pp 177-183

TAMAROV, V. A., Tomsk State University, Scientific Research Institute of Applied Mathematics and Mechanics

[Abstract] Results are presented from the first stage of a work intended to derive and analyze equations considering all terms up to order  $J_2\gamma$  for the case of motion of a satellite in a noncentral field and in the field of gravity of an external body. Estimates were generated for various orbits of artificial earth satellites and compared with the direct influence of the perturbing factors considered. References 11: 9 Russian, 2 Western. [115-6508]

UDC: 520.8.05

#### PROBLEM OF DETERMINING HIGHLY ACCURATE COORDINATES OF ARTIFICIAL SATELLITES BY PHOTOGRAPHIC METHOD

Moscow ASTRONOMICHESKIY ZHURNAL in Russian Vol 61, No 1, Jan-Feb 84  
(manuscript received 8 Dec 82) pp 184-189

DUMAN, D. P., Main Astronomical Observatory, Ukrainian Academy of Sciences

[Abstract] Problems which must be solved by determination of highly accurate positional observations of satellites include construction of an inertial system of coordinates for radio sources and its tie-in with the inertial system of coordinates based on optical observations of the stars. Solution of this problem requires the use of angular coordinates primarily of distant satellites, whose motion is little disturbed by the influence of higher harmonics of the terrestrial gravitational field and atmosphere. The problem of determining the angular coordinates of satellites by photographic methods with great precision includes a number of independent sections. The solution requires an increase in the focal length of the lenses

used in satellite cameras. Furthermore, satellite observations must be performed with fast lenses, due to the low brightness of most satellites. Third, radiation receivers should be photographic plates capable of producing images 20-30  $\mu\text{m}$  in diameter. Fourth, an accurate catalog of stellar positions is required for tie-in of the satellite position. Finally, computers must be used to process measurement data. The most promising method of increasing the accuracy of determining the angular positions of high altitude satellites by a factor of 2 to 3 is to use wide angle astrographs with focal length at least 2 m, lens diameter at least 40 cm, made using special satellite tracking cameras with exposure time of  $10^{-3}$  s. Figures 2; references 15: 13 Russian, 2 Western.  
[115-6508]

UDC 524.7

OBSERVATIONS OF 15 RADIO GALAXIES FROM BOLOGNA SURVEY USING RATAN-600 RADIO TELESCOPE

Moscow PIS'MA V ASTRONOMICHSKIY ZHURNAL in Russian Vol 10, No 2, Feb 84  
(manuscript received 1 Aug 83) pp 90-93

MALUMYAN, V. G., Byurakan Astrophysical Observatory, Armenian SSR Academy of Sciences

[Abstract] Results are presented from observations of 15 radio galaxies in the Bologna survey (B2 as follows: 0055 + 26, 0222 + 36, 0331 + 39, 0722 + 30, 0836 + 29, 0844 + 31, 0916 + 34, 1040 + 31, 1101 + 38, 1141 + 37 NE, 1322 + 36, 1346 + 26, 1515 + 29 observed at 3.66 or 3.95 GHz; and B2 1350 + 31 and 1626 + 39 observed also at 0.97 and 7.69 GHz), using the RATAN-600 radio telescope. Results are shown in tabular form and discussed individually. A halo measuring 6'-7' was observed around galaxy B2 1141 + 37; anomalies in observations of this galaxy are discussed. References 9: 2 Russian, 7 Western.  
[144-9642]

## OBSERVATION OF GAMMA RADIATION FROM CRAB NEBULA IN 5-100 MeV RANGE

Moscow PIS'MA V ASTRONOMICHESKIY ZHURNAL in Russian Vol 10, No 2, Feb 84  
(manuscript received 5 Aug 83) pp 104-110

IYUDIN, A. F., KIRILLOV-UGRYUMOV, V. G., KOTOV, Yu. D., SMIRNOV, Yu. V. and YUROV, V. N., KURNOSOVA, L. V. and FRADKIN, M. I., DAMLE, S. V., GOKHALE, G. S., KUNTE, P. K. and SREEKANTAN, B. V., Moscow Engineering Physics Institute; Institute of Physics imeni P. N. Lebedev, USSR Academy of Sciences, Moscow; TATA Institute of Fundamental Research Bombay, India

[Abstract] Results are presented from observations of gamma radiation from the Crab Nebula within the energy range 5-100 MeV, conducted 6-7 November 1980 using a "Nataliya-1" gamma telescope in aerostat flight. The structural layout of the telescope is shown and the observation procedure is described. The observations were carried out at latitude 8°N (Hyderabad city, India) over 6-hour periods. A total of 3,700 events were registered. Data were processed in two stages: classification of events (pairs, singlets, background) and determination of track; and a determination of energy for each useful event from the value for repeat scattering of secondary charged particles and the direction of gamma quanta. Events were assigned to one of two energy ranges, viz. 5-20 MeV and 20-100 MeV. Differential fluxes were determined using parallel coordinates and a cross-correlational procedure. Differential gamma fluxes were as follows:

$$I_{\gamma}(5-20 \text{ MeV}) = 2.1 \pm 0.3 \cdot 10^{-5} \text{ } \gamma/\text{cm}^2\text{s}\cdot\text{MeV}$$

$$I_{\gamma}(20-100 \text{ MeV}) = 1.0 \pm \begin{matrix} 0.1 \\ 0.2 \end{matrix} \cdot 10^{-6} \text{ } \gamma/\text{cm}^2\text{s}\cdot\text{MeV}$$

Results agree quite well with earlier published findings and do not support the idea of significant excess in the range 5-20 MeV. Figures 5; references 17: 2 Russian, 15 Western.  
[144-9642]

## SOLAR FLARES AND LABORATORY EXPERIMENTS ON MAGNETIC RECONNECTION IN CURRENT SHEATHS

Moscow PIS'MA V ASTRONOMICHESKIY ZHURNAL in Russian Vol 10, No 2, Feb 84  
(manuscript received 25 Jul 83) pp 149-153

BULANOV, S. V., DOGEL', V. A., and FRANK, A. G., Institute of Physics  
imeni P. N. Lebedev, USSR Academy of Sciences, Moscow

[Abstract] Laboratory experiments to model processes in solar flares are described, with special reference to the problem of the dynamics of highly conductive plasma in the vicinity of the particular, especially the zero line of the magnetic field. Approximation modeling is done by comparing the values characterizing the physical conditions in the active clouds of the solar corona and in the atmospheres of flare stars, and in series of laboratory experiments devoted to a study of the formation, stability and explosive disruption of current sheaths in the vicinities of zero lines of the magnetic field, namely the University of California Riverside DIPD experiments, the Frank and the Kiriy "Current Sheath" experiments, and the FPD experiments conducted at UCLA by Stenzel et al. Analysis of plasma flow is based on the relationship of gas kinetic pressure and magnetic pressure, the parameter for nonlinearity, and the Reynolds magnetic number, but disregarding other dissipative processes. It is shown that within the framework of this limited modeling in DIPD and "Current Sheath" the physical characteristics typical of the preflare situation in the Sun and in stars can be satisfactorily reproduced from the viewpoint of the buildup of magnetic energy; and hence, should correctly reproduce the main physical processes occurring during flares. Thus, there is qualitative analogy between the main phenomena of explosive disruption of the current sheath in laboratory experiments and the pulse phase of star flares.

References 31: 14 Russian, 17 Western.

[144-9642]

## INTERPLANETARY SCIENCES

KOVTUNENKO ON 'VENERA-15, -16' AND 'VEGA' PROJECT

Moscow NEDELYA in Russian No 23, 4-10 Jun 84 p 21

[Article by V.M. Kovtunenکو, corresponding member, Ukrainian SSR Academy of Sciences; Hero of Socialist Labor; laureate, Lenin and USSR State Prizes; technical director, Venus Research Project: "The Path to Venus"]

[Text] Several months ago the world learned about Soviet science's new and notable success in the investigation of the planets in the Solar System: during the flight of the "Venera-15" station in orbit, this artificial Venus satellite obtained, for the first time, unique radar images of sections of Venus's surface that are inaccessible for observation from Earth. Following the "Venera-15," the "Venera-16" station began to function. At this very moment, scientists are already conducting regular radar probes of Venus with the help of these two automatic spacecraft. V.M. Kovtunenکو spoke about this to journalists from the newspaper PRAVDA UKRAINY.

"I would immediately like to emphasize," says Vyacheslav Mikhaylovich Kovtunenکو, "that success in the new stage of the investigation of this planet was insured by the labor of many collectives of both a scientific and a production nature.

"What do Earthmen now know about the Morning Star? The pressure on Venus's surface is not 10 atmospheres, as was assumed at first, and not even 25, but about 90 atmospheres with a temperature of about 460°. The planet's cloud cover is made of droplets of sulfuric acid, and its atmosphere consists of 97 percent carbon dioxide. The extraordinary dryness of the atmosphere has also been registered: it contains only hundredths and thousandths of a percent of water vapor.

"Previously, Venus's surface was investigated in relative detail only in those few places where automatic spacecraft arrived from Earth and landed. We have now formulated the problem on a larger scale, and its solution should help us more or less 'glance over' very large areas of the planet's surface, evaluate different structures in its relief, and--possibly--perceive features of the formation of Venerian mountains and lowlands and penetrate the secrets of geological processes taking place on Venus, so at the same time to gain a better understanding of the Earth's past.



"The properties of Venus's opaque atmosphere, which are already known to science, make any optical observations of its surface impossible. However, what cannot be done in the optical band can be achieved with the help of radar, for which opaqueness of the atmosphere is no hindrance.

"Under the scientific direction of Academician V.A. Kotelnikov, the highly efficient and compact 'Polyus-V' radar set was created by the Moscow Power Engineering Institute's Design Office, which is headed by USSR Academy of Sciences' Corresponding Member A.F. Bogomolov. The on-board equipment's increased power supply requirements were satisfied by almost doubling the area of the solar batteries. The on-board radio transmitters were made more powerful and there was a significant increase in the diameter of the high-directional parabolic antenna, which is used to transmit to Earth the information that has been collected. Thanks to this it became possible to send 100,000 bits of information per second.

"We will also long remember the strain of waiting, along with those happy minutes when we, the directors and leading specialists, along with the participants in the experiment, who had gathered at the 'Medvezh'1 Ozerka tracking station near Moscow, first saw on the screen frames that had been transmitted from the 'Venera-15' and reproduced from magnetic tape. And then we were already examining in more detail the fresh 'photographs' on which the radar information was transformed into pictures of mountain ranges and plateaus, canyons and scarps, faults and hilly plains, uplands and craters. Every square millimeter in a 'picture' obtained from Venus corresponds to a section of this planet's surface that measures a square kilometer. During the filming and transmission of the information we succeeded in achieving very good resolution: it is possible to distinguish details of the Venerian relief that are 1 or 2 kilometers long.

"Communication sessions with the 'Venera-15' and 'Venera-16' are held every morning. One session covers a strip 150 kilometers wide and 9,000 kilometers long. From these strips, as if 'sewn together' one after another, a map of Venus is being made. The plans are to cover 60 million square kilometers of this planet's surface by radio-mapping. Special attention is being given to the northern polar area, which until now has not been studied at all.

"Parallel with these investigations, feverish preparations are being made for the execution of the large, integrated 'Vega' project, which provides for the launching of automatic spacecraft toward Venus in 1984. Three basic problems are to be solved. One of them--the study of the Venerian atmosphere--will be solved for the first time with the help of balloon probes. The second is a direct investigation of the planet, on which descent vehicles should land. The third is related to Halley's Comet, which is now approaching the Sun. The interplanetary station's flight vehicle will continue its voyage from the neighborhood of Venus around the Sun in the Sun's gravitational field. The station's motion will be corrected so that in March 1986 its track will intersect the trajectory of Halley's Comet. It is expected that our vehicle will fly in the vicinity of 10,000 kilometers from the comet's nucleus; that is, it will fly through its 'coma,' or 'atmosphere' of gas and dust.



The preparation of this experiment requires extraordinarily accurate, reliable and highly efficient guidance and tracking systems, among others. Our colleagues from Bulgaria, the GDR, Hungary, Poland, Czechoslovakia, Austria, France and the FRG are working within the framework of the 'Vega' project along with Soviet scientists and designers. The participating countries are developing various scientific instruments and equipment for the upcoming investigations. Specialists from countries with different social systems are united by a common goal and are working together well for the benefit of investigating space for peaceful purposes.

## TWO-LEVEL MODEL FOR FORMATION OF NIGHT IONOSPHERE OF VENUS FROM RADIO OCCULTATION EXPERIMENTS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 276, No 2, May 84  
(manuscript received 17 Sep 83) pp 325-328

OSMOLOVSKIY, I. K., SAVICH, N. A. and SAMOZNAYEV, L. N., Institute of Radio Engineering and Electronics, USSR Academy of Sciences, Moscow

[Abstract] Although available data from radio occultation experiments (Venera-9 and Venera-10 (1975) and Pioneer and Verna stations (1978)) show that during years of low solar activity the electron concentration in the night ionosphere of Venus has two maxima (is two-level), the reasons for this have not been clarified. In this paper a two-component diffusion model ( $O^+$  and  $O_2^+$ ) is proposed to describe the natural formation of the one- or two-maximum electron concentrations as a function of physical conditions in the Venusian atmosphere. The basic idea is to find those conditions in which  $O^+$  plasma moves from the day side to the night side, in which the upper maximum formed in a descending stream of  $O^+$  ions stops at a given maximum forming in the descending stream because of the  $O_2^+$  ions formed as the result of chemical reactions between the  $O^+$  ions and  $CO_2$  molecules. The mathematical apparatus is described. The consistency of the model is checked against "typical" profiles having one or two maxima. Specific experimental results are discussed in terms of electron concentration and temperature of the neutral atmosphere and the correctness of model calculations is shown. It is intended to use the model also to investigate the contribution of epithermal electrons in the formation of the Venusian night atmosphere. The paper was presented by academician V. A. Kotel'nikov on 26 August 1983. Figures 2; references 12: 2 Russian, 10 Western. [143-9642]

## INFRARED THERMAL RADIATION OF VENUS

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 22, No 2, Mar-Apr 84  
(manuscript received 16 Aug 82) pp 252-266

KSANFOMALITI, L. V.

[Abstract] The thermal IR radiation of Venus originates primarily in the upper cloud layer. Only about 12% is formed in the gas medium in the mesosphere by carbon dioxide. The radiation of the clouds is severely darkened at the edge of the disk. Terrestrial radiometry, due to its limited resolution, rarely observes less than 1/20th of the surface of the planet. The distribution of albedo by latitude and longitude are presented in tabular form. A diagram illustrates the distribution of thermal departing radiation flux in an equatorial cross section of the planet. The distribution of thermal radiation is mapped in the 11.5  $\mu\text{m}$  band; secular change in the nature of thermal radiation are diagrammed. The equilibrium temperature of the planet is reported to be 228 K, the bolometric albedo 0.766. There is a strong diurnal component to the variation, with night side radiation somewhat stronger than day side radiation. Figures 10; references 44: 7 Russian, 37 Western.  
[130-6508]

H<sub>2</sub>O PROFILE IN LOWER ATMOSPHERE OF VENUS BASED ON EFFECTIVE RADIATION FLUX MEASUREMENTS

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 22, No 2, Mar-Apr 84  
(manuscript received 8 Jul 82) pp 267-272

MAROV, M. Ya., GAL'TSEV, A. P. and SHARI, V. P.

[Abstract] The purpose of this work is to determine the profile of water content in the Venusian atmosphere based on known results of CO<sub>2</sub> and H<sub>2</sub>O nontransparency spectral measurements and data from measurements of radiation bands in the Venusian atmosphere. The method used is stricter than that used in previous studies. Direct measurement by spacecraft confirm the conclusion that H<sub>2</sub>O vapor content decreases with increasing altitude and varies greatly over time and space. The presence of an adiabatic temperature gradient indicates that there is complete mixing in the lower layers of the Venusian atmosphere. Figures 4; references 16: 9 Russian, 7 Western.  
[130-6508]

## CHANGE IN VENUSIAN ATMOSPHERE ABSORPTION COEFFICIENT WITH ALTITUDE

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 22, No 2, Mar-Apr 84  
(manuscript received 5 Apr 82) pp 273-278

YANOVITSKIY, E. G.

[Abstract] This article is intended to show a method of directly determining the distribution of absorption coefficient  $\kappa(h)$  as a function of height in the Venusian atmosphere by measurement of the amount of light striking a horizontal area both from above and from below over a broad range of wavelengths between 0.5 and 1.2  $\mu\text{m}$ . Such measurements were performed by the "Venera-9", "Venera-10" and Pioneer-Venus spacecraft. Such measurement is sufficiently reliable, allowing direct determination of the volumetric absorption coefficient  $\kappa(h)$  and complete restoration of the field of radiation in the deeper layers of the atmosphere, using equations presented in this article. Figures 1; references 12: 7 Russian, 5 Western.  
[130-6508]

UDC: 621.371:523.42

## THEORETICAL STUDY OF ELECTRON CONCENTRATION IN VENUSIAN ATMOSPHERE AS FUNCTION OF ZENITH ANGLE OF SUN AND SOLAR ACTIVITY IN AREAS OF PHOTOCHEMICAL EQUILIBRIUM

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 22, No 2, Mar-Apr 84  
(manuscript received 10 Mar 81; after revision 21 Jul 82) pp 279-291

PAVLOV, A. V.

[Abstract] This work studies the area of altitudes from 100 to 200-220 km with sun zenith angles of between 0 and 90°. A model derived in an earlier work is used to study the variation in electron concentration in the area of the major and minor maxima of the Venusian daytime ionosphere as a function of solar zenith angle and solar activity. Further studies of the physical and chemical processes determining the composition of the ionosphere are planned to simplify the method of theoretical modeling of the ionospheric composition. It is shown that at the lower maximum the calculated values of  $N_e$  do not fit linear variation of  $N_e$  as a function of  $(Ch \chi)^{-1/2}$  as is suggested in the simple layer theory of Chapman. The areas of the major and upper electron concentration maxima are formed primarily by solar radiation at between 250 and 900 Å, at the lower maximum - by solar radiation at 10 to 200 Å and photoelectrons. A group of chemically active components is identified whose concentration is determined by photochemical reactions with the participation of only oxygen, carbon, carbon monoxide, carbon dioxide and helium ions, electrons and neutral components. Figures 5; references 51: 16 Russian, 35 Western.  
[130-6508]

## FORBIDDEN LINES OF OXYGEN IN COMET SPECTRA

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 22, No 2, Mar-Apr 84  
(manuscript received 1 Mar 83) pp 292-296

KRASNOPOL'SKIY, V. A.

[Abstract] Detailed spectroscopic observations of comet Bradfield at 1200-3400 Å by the IUE satellite and terrestrial photometric measurements of the primary emissions in the visible portion of the spectrum have yielded extensive experimental materials which can be used to analyze the 6300/64 Å doublet, among the strongest emissions in the spectral area from 6000 to 10,000 Å. Measurements indicate that the yield of  $O(^1D)$  and  $O(^1S)$  states upon dissociation of  $H_2O$  are 9% and 1%. The mean velocities of the two atoms are computed. Interferometric measurements of the width of the 6300 Å line, its intensity and distribution of intensities at various distances from the core of comet Kohoutek agree well and indicate a gas liberation rate of the comet of  $Q_{H_2O} \sim 0.5 \cdot 10^{29} s^{-1}$  and  $Q_{CO_2} \sim 0.2 \cdot 10^{29} s^{-1}$  per Au. References 20 (Western).

[130-6508]

## SPACE ENGINEERING

### DEVELOPMENT OF SPACE INSTRUMENTATION BY 'INTERCOSMOS' MEMBER COUNTRIES

Moscow PRAVDA in Russian 22 May 84 p 3

[Article by V. Balebanov, deputy director, Institute of Space Research, USSR Academy of Sciences: "Cooperation in Space"]

[Text] During the flight of the Soviet-Indian international crew, the cosmonauts carried out an extensive scientific program. The technical basis of many of the experiments was equipment created especially for this flight by the joint efforts of Soviet and Indian scientists, as well as the ship's and orbital station's regular equipment. This equipment included instruments developed during the preparations for the preceding international expeditions. In this matter, two of the special features of the international research programs were the use of previously accumulated experience and continuity of the experiments.

V. Balebanov, deputy director of the USSR Academy of Sciences' Institute of Space Research, tells about the international collaboration of scientists for the creation of equipment for the study of space.

The equipment used for space research is usually unique. Close international cooperation is helping to support the development of scientific instrument building at the same rate as the course of scientific and technical progress.

One of the main features of the socialist states' collaboration in the matter is mutual enrichment by all the very best that there is in instrument building in the CEMA member countries. The idea behind the "Intercosmos" program is to use the strongest aspects of each of the partners for the common good.

The German Democratic Republic, for example, is noted traditionally for the high level of its optical and electronics industries. There, such leading scientific research and industrial enterprises as Karl Zeiss-Jena, the Robotron combine and others have been enlisted for the development and production of equipment for satellites and rockets.

For instance, the MKF-6M multizonal space photography system is now operating on board the "Salyut-7." It was created by the joint efforts of scientists and



specialists from the USSR and the GDR and is intended to be used to study the Earth's natural resources. In the GDR alone, 20 scientific research establishments and organizations participated in this work.

Instruments with the universally known brand name (Tesla-Vust) and equipment from other industrial enterprises in Czechoslovakia were placed on almost all the satellites bearing the "Intercosmos" emblem and the "Vertikal" rockets. Each of these instruments was a material embodiment of progressive scientific ideas and the inventiveness of designers and experimenters.

Hungarian specialists are traditionally strong in the field of electronics and computer technology. Their experience is particularly valuable during the development of highly informative measuring systems. The first on-board micro-processor was used in the Soviet-Hungarian "Plazmag" experiment on the "Prognoz-7" satellite.

Scientists from Romania specialize in the creation of highly sensitive magnetometers, as well as equipment for the registration of cosmic radiation (high-energy nuclei) from on board satellites.

The study of the Earth from space requires the extensive use of spectrometric equipment. The "Spektr-15" instrument, which was created in Bulgaria and has been tested repeatedly--it is also on board the "Salyut-7"--makes it possible to determine how beams of light are reflected from the Earth's surface and what are the results of interference engendered by atmospheric water vapor and aerosols. The MKS multizonal spectrophotometer was installed for the first time in the "Intercosmos-20" and "Intercosmos-21" satellites. This instrument was an organic combination of scientific methods developed by scientists in the USSR and equipment created by specialists from the GDR. An improved version of this instrument is functioning successfully on board the "Salyut-7" orbital station.

Instruments, separate pieces of equipment and various devices that were developed by specialists from the socialist countries and initially intended for space research are being used in the national economy. For example, the Fourier spectrometer, which was created by scientists in the GDR and is functioning successfully on board the "Venera-15" and "Venera-16" stations, is being adapted for the conduct of highly accurate chemical and biochemical investigations and rapid analysis at chemical enterprises. The special tape recorders that were originally intended for use in the unified telemetric system that is utilized on satellites in the "Intercosmos" series are being used as capacious memory units for the portable control computers that are needed in the most variegated areas of the national economy. Bulgarian industry alone is already using more than 80 space instruments and techniques to solve terrestrial problems. They include a very sensitive magnetometer that is capable of detecting changes in a magnetic field's intensity on the order of one-tenth of a gamma. For geophysical work, Bulgaria previously bought magnetometers in Canada; their sensitivity was worse by a factor of 20-30.

At least 10 instruments that were created in the socialist countries for the conduct of medical and biological research during the flights of the international expeditions have found a use in Earth medicine. They include the

Hungarian "Balaton," the Czechoslovakian "Oksimetr," the Polish "Kardiolider" and others.

On the basis of the breadth of the problems encompassed and the amount and quality of the equipment being developed, the research that the scientists from the fraternal nations have now developed is about as valuable as that done during the last 15 years under the "Intercosmos" program.

In Czechoslovakia, for example, an automated, stabilized platform has been developed with the participation of Soviet specialists. It will be used to hold scientific equipment for the investigation of Halley's Comet (the "Vega" project). The creation of this platform has no precedents in the practice of scientific instrument building for use in space. About 40 scientific research and production enterprises in Czechoslovakia participated in its production.

In Hungary, a television system was produced for this same project. It embodies a further development of Soviet scientists' idea about the creation of the "Fragment" specialized space television system, which has already been operating for 4 years on board a "Meteor" satellite.

The "Vega" project's television system should detect the comet and its nucleus and provide automatic tracking of them and transmission of spectral images with maximum detail to the ground reception points. The system includes an on-board computer for preliminary processing of the images and computation of the coordinates of the comet's nucleus. Data from the television system will also be used to control the rotatable platform. The use of the newest materials, techniques and achievements in the fields of optics, mechanics and microelectronics made it possible to achieve a record low weight (31.5 kg, in all) for such a complex and powerful optical system.

A promising field for international collaboration in recent years was research in space technology. The materials for it were produced in the participating countries with due consideration for the specific nature of the development of national science and industry. For experiments on board the "Salyut-7," for instance, Indian specialists selected a silver-germanium alloy because they had accumulated experience in the technical purification of such alloys. One of the important problems facing scientists is the development of on-board equipment with high stability for the maintenance of given technological process parameters during the entire time of conduct of an experiment. Czechoslovakian specialists, together with their Soviet colleagues, recently created the new "Kristallizator" furnace for the conduct of technological research on board an orbital station on a semi-industrial scale.

Soviet and Czechoslovakian specialists have jointly developed the BROD (on-board data registration and processing) for the rapid collection of the entire spectrum of signals and the "compression" of information during its transmission to Earth. It is a microcomputer that controls measurements on board a spacecraft, records data and performs preliminary processing on it, and then distributes it among the telemetric channels for transmission to Earth.

The extensive use of the principles of systematization and standardization, the creation of a basic system of instruments, and the effective improvement of

methods and systems for making integrated use of them is one of the most important conditions for the further regular development of the building of scientific instruments for use in space. Scientists have also concentrated their efforts on this during the realization of plans for joint research and experiments in the near future in all the basic fields covered by the "Intercosmos" program.

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## SPACE APPLICATIONS

### SPACE RESEARCH BENEFITS NATIONAL ECONOMY

Moscow POLITICHESKOYE SAMOOBRAZOVANIYE in Russian No 1, Jan 84 pp 58-66

[Article by I. Yegorova and Yu. Zaytsev: "Space--For the National Economy"]

[Text] The extensive growth of information in all of man's spheres of activity is characteristic for our epoch. Aside from the progressive development of traditional means of information transmission -- telephone, telegraph, and radio broadcasting, the need has arisen for creating new aspects -- television, information exchange in automatic control systems and electronic computers, transmission of newspaper matrices, etc. Communications channels used to obtain reference, patent, bibliographical data, facsimile materials, blue-prints, photographs, information from banks (accounts) and various types of data are beginning to play a noticeable role.

The consolidation and unification of many previously autonomous enterprises and sectors of our national economy into a unified national economic complex and the increased dynamism of their activity have conditioned a significant increase in direct and reverse production communications. (It is considered that the volume of information transmitted over communications channels is proportional to the square of the industrial potential). Naturally, the traditional means of communication are being constantly improved.

However, their further development is already encountering significant difficulties of a technical as well as of an economic character. Thus, for our country, with its huge territory and varied, often complex and severe climatic conditions, one very serious problem is the satisfaction of the increased demands for the carrying capacity, quality and reliability of long-range communications and specifically the general organization of wide-band channels for transmission of television programs.

In April of 1965, the first Soviet communications satellite, "Molniya-1", was launched into an elliptical orbit. As of 1967, the space communications system "Orbita" went into operation. Soviet industry not only developed the equipment for the "Orbita" stations within a short time, but also organized its series production. By the 50th anniversary of the Great October Socialist Revolution, a system comprised of 21 stations was already in operation. These stations were located in the remote regions of Siberia, the Far East, Central Asia and Kazakhstan. The number of television viewers for the first Central

Television program immediately increased by 20 million persons. At the present time, around 100 major and around 1,000 minor receiving stations have been built. All of them are tied in to a single system, which continues to be expanded and improved.

Soviet specialists, having performed a comparative economic analysis of the satellite communications system with radio relay and cable lines, came to the conclusion that the application of space is economically expedient in transmitting information to distances of over 200 kilometers.

The expenditures for the construction of the first 60 stations in the "Orbita" system comprised around 100 million rubles. The construction took seven years. The creation of an equivalent system of radio relay or cable transmission of television signals would have required expenditures in the sum of several billion rubles and would have taken several decades. Thus, from a technical-economic standpoint, the space communications system already at its first stage of organization turned out to be quite capable of competing with ground-based communications lines. Its qualitative indicators are better than those of ground lines spanning very long distances. At the same time, space and ground lines mutually augment each other. The first makes it possible to quickly create "centers" of communication, to which the traditional ground network lines are gradually joined.

The system of space communications ensures not only the solution of national problems necessary for meeting the domestic needs of each country, but at the same time expands the possibilities for international information exchange. Ground stations for communication via Soviet satellites have been built practically in all the CEMA member states and are being successfully utilized.

In the 20th century, in connection with the development economic management activity, the significance of the weather service has increased to the point that normal operation of many sectors of the national economy cannot be imagined without precise meteorological information and predictions. The study of the climate and improvement of methods for weather prediction are examined as a serious national economic problem in the documents of our party.

In the USSR there are around 4,000 meteorological stations, 7,500 meteorological posts, and 600 hydrological observation centers. Synoptic observations are conducted by special laboratories mounted on airplanes and helicopters. Means of observing the atmosphere from space have firmly taken their place in meteorology. A special branch of science dealing with the atmosphere has been born and is taking on strength -- satellite meteorology.

With the launching of the "Cosmos-144" satellite in February of 1967, the meteorological space system "Meteor" was placed into operation in the Soviet Union. It significantly augments the data obtained from ground observations and makes it possible to increase the accuracy of weather prediction. For over 15 years, two or three "Meteor" satellites have been working simultaneously within the system. They "look over" our planet twice in a 24-hr period, each time gathering information on the cloud cover and the heat radiation leaving approximately 70-80 percent of the earth's surface. When passing over Moscow,



Novosibirsk and Khabarovsk, the satellites transmit the gathered information to Earth. The "Meteor" satellite relates a hundred times more information on the weather in only a single orbit than 15,000 meteorological stations on earth. Satellite observations of the cloud cover, obtained in the form of photographic images, make it possible to study the picture of cloud distribution over the earth's surface, to determine the position, activity and movement direction of cyclones and atmospheric fronts, to judge the distribution of precipitation zones over the earth's surface, to trace the effect of local relief on cloud formation, etc. Thanks to the increased accuracy of weather prediction, the "Meteor" space system, using data which is far from complete, makes it possible to conserve material goods in the sum of almost a billion rubles annually.

Satellites have also proven to be an effective means of studying ice movements in the aquatoria of the seas and oceans. Television photographs fix the position of large channels, pools of open water in ice, air holes in ice, and accumulations of finely broken ice. This, in particular, has a huge significance for navigation in the Arctic and for increasing its duration.

The selection of optimal courses for ocean-going vessels according to space predictions yields a great economy for our country. The organization of long-range non-stop flights such as Moscow-Magadan or long-range international airline flights of the Moscow-Hanoi type would be practically impossible without using the operative data of meteorological satellites.

International cooperation and a wide exchange of satellite data are called upon to play a great role in the development of space meteorology. The space system comprised of three or four satellites operating at near-polar orbits (such as the Soviet "Meteor") and several geostationary meteorological satellites is considered to be the most effective. The latter seem to hang over the equator at an altitude of 36,000 kilometer, rotating synchronously with the planet and constantly "surveilling" the same part of the earth's surface all the time. A system of 4-5 geostationary satellites "encompasses" the entire earth's surface with its observations along the equator from 60° north latitude to 60° south latitude. The combination of geostationary satellites with low orbital ones makes it possible to obtain information within the scope of the entire planet and to significantly improve the supply of meteorological information to various sectors of the national economy.

From the very first years of existence of Soviet authority, our party and state have given principle significance to works on studying the country's natural resources, their rational application and reproduction, and the creation of new methods and means of using nature. The task of studying the country's natural resources for the good of socialist construction was presented by V. I. Lenin as early as the beginning of 1918 in his well-known "Sketch for a Plan of Scientific-Technical Work." Since that time, hundreds of organizations are performing expedition and on-site studies of the country's territory in a planned and goal-oriented matter, as well as studies of the adjoining seas and the World Ocean.



At the current stage, when practically all the basic types of the earth's natural resources have been involved in economic mastery and the scope of production is so grandiose that man's activity is significantly expressed in the surrounding environment, the further study and protection of natural resources takes on particular importance. Finding new natural riches and scientifically substantiating the possibility of their most rational application in order to reduce the harmful effects on the environment to a minimum -- this is one of the most important tasks in utilizing nature. It may be solved only on the basis of modern scientific and technical achievements.

In recent years, much attention has been given to the so-called remote methods in studying the earth's natural resources. The essence of these consists of the fact that the physical parameters of the earth's surface, the ocean and the atmosphere are determined by measurements of the earth's radiation characteristics, taken from on board space apparatus. In the USSR the basic work on studying the Earth from space is being done with the aid of the manned "Salyut" stations and the "Meteor" and "Cosmos" satellites. According to preliminary computations, the economic effectiveness of utilizing the data from long-range sounding of the Earth from space in agriculture and forestry, geology and mineral surveys, hydrology and water resource management, oceanography and evaluation of the marine resources, geography and control of the environment may comprise 500-600 million rubles per year.

The following fact is notable. The first expedition on the orbital station "Salyut-4" comprised of Aleksey Gubarev and Georgiy Grechko in 1975 performed national economic tasks in the interests of forty organizations and departments. Today, however, the number of organizations using information obtained from space has increased over 10-fold. On the whole, in our country there are 1,200 scientific-research, project design, production organizations, higher and secondary special educational institutions who are interested in utilizing the data obtained from Earth sounding from space. Specialists have computed that in two months of work by the crew in the summer of 1975, the photographs taken from space alone have yielded an economic effect of 50 million rubles. Five minutes of taking pictures from space replace constant two-year aerial photography of this same region from on board an airplane. In the course of their 150-day flight on board the orbital station "Salyut-7", cosmonauts Vladimir Lyakhov and Aleksandr Aleksandrov devoted the greatest part of each work day to the study of natural resources.

Soviet scientists have made a great contribution to developing methods of observation from space and creating the basics of space ecology as one of the leading sectors in modern space research. Our country's science has proposed a number of interesting methodologies for obtaining and processing information on earth processes taken from space. In accordance with these, industry has developed, perfected and installed original instruments and scientific apparatus on board the space vessels.

The so-called multi-zonal method has become most widespread in studies about the Earth taken from space. It is based on the measurement of the radiation of each of the studied elements on the earth's surface simultaneously within several narrow spectral sections. Specifically, herein lies the whole secret:

Each place on the earth's surface -- be it cliffs, fields or structures built by man -- has its own spectrum. The character and intensity of the irradiation from various objects within the same spectral zones may differ insignificantly. However, in other zones the difference is most strongly manifested and makes it possible not only to discern these objects, but also to clarify their physico-chemical peculiarities which are not discernible to the eye. Thus, it is possible not only to see geological breaks, but also to distinguish rocks of various mineralogical content, to obtain information on soil moisture content, water salinity and pollution, and the degree of perturbation in the sea.

Despite the relatively short time of application of space methods and means in studying the face of the Earth, important scientific and practical results have been obtained in this direction. Broad prospects are opened for using such means and methods for solving major national economic problems. Let us take, for example, the problem of development of the material-technical base for the country's agro-industrial complex, on the basis of which the USSR Food Program which was developed by the party is presently being implemented.

Here is some general information. The land resources of our country comprise 2,227.5 million Ha, of which 227.4 million Ha are used for plowed lands. For effective management of agricultural production it is necessary to monitor many rather fast-moving processes which develop over great territories. The character of soil moisture content, the formulation and course of the snow covering, the rate of ripening of agricultural cultures, the clarification of centers of disease and their observation -- all this and much more requires effective, periodically repeating and, most important, precise information.

Let us imagine that in some specifically selected oblast which unites several rayons and takes up a territory comprised of hundreds of thousands of hectares, it is necessary in the spring to select the optimal times for sowing grain. Not only within the scope of the oblast, but even within the boundaries of a single rayon these times may be quite varied. They depend on many factors, primarily on the readiness of the soil to accept the seeds, which is characterized by its temperature and degree of moistness. Often these decisive parameters are estimated, while the sowing times are determined from personal experience and advice of "people in the know", which is by far not always sufficiently substantiated. From space, however, it is possible to photograph the entire territory of the oblast in several minutes, to efficiently process the information and obtain the necessary data. The analysis of the specific conditions in each rayon, even in an individually selected kolkhoz or sovkhov, makes it possible to make substantiated decisions.

The need for irrigation may be determined in exactly the same way, based on the actual moisture content of the soil, and the dynamics of crop maturation may also be monitored. In the first case, moisture is directed to the sections requiring immediate watering in a quick and substantiated fashion. In the second case -- a schedule of crop harvesting sequence is compiled and the concentration of technology is redistributed and monitored on the most crucial sectors.

Not so long ago, detailed medium- and small-scale maps of administrative rayons, oblasts, and individual regions were compiled primarily on the basis of large-scale maps and plans of kolkhozes and sovkhozes. In this case, their content depended greatly on the experience of the cartographer, his level of training, and how he generalizes factual data. On the whole, however, this was a very labor consumptive, prolonged, and expensive process.

Space photography of the earth's surface has radically changed the technological principles of compiling cartographic documents. On space photographs the objects in the locale are already represented in a generalized form. Therefore it has become possible to create rayon and oblast maps using direct materials from space photographs in the required scale and with the necessary degree of detail. This is not only economically expedient, but also sharply increases the technical level and quality of map making. Moreover, as we have already noted, space technology makes it possible to perform photography work over rather significant territories within relatively short time spans.

The photographs, enlarged by several tens of times, obtained in space with the aid of the MKF-6 camera mounted on the "Salyut-6" and "Salyut-7" stations are fully suitable for topical agricultural cartography. Also, the same negative may be used to make different photographic bases for compiling regional, oblast, and in a number of cases even rayon maps. These may be soil maps, geobotanical or other types of maps, of any scale and any degree of periodicity. This, in turn, makes it possible to create optimal variants for locating agricultural cultures and crop rotations, and for planning roads, settlements, various agricultural enterprises, and structures. The materials from space photography may also serve the purposes of planning and predicting land use, regionalization of the land resources, and compilation of the land evaluation cadaster.

Today, when the influx of space information for agricultural needs is ever expanding, it is evident that many aspects of the very character of agricultural production management must soon change. At the present time, operative management is based generally on information which is obtained at ground level. The application of space technology gives information of any degree of generalization -- in the scope of the entire country, individual republics, oblasts, rayons, and even kolkhozes and sovkhozes. This will make it possible to efficiently conduct management from above and to implement effective control.

The intensification of agricultural production which has developed on the basis of extensive land reclamation and chemization, as well as the development of production on the whole, have greatly increased man's influence on nature. Therefore, obtaining rapid information on the results of our farm management activity has become a vital necessity. We know that in our country around 17 percent of the arable land is subjected to wind and water erosion, which reduces the crop yield of agricultural cultures. Photographs taken from space make it possible to determine the presence, character and dynamics of the erosion processes. Dust-sand and dust storms may be easily observed from the orbit. The photographs register instantaneous pictures of their spread throughout huge territories. This makes it possible to determine the size of the storms, their spheres of development, direction of movement, and to evaluate the role of tree plantings in attenuating dust-soil-sand flows and storms.



The systematization of satellite information on these phenomena makes it possible to embark upon the compilation of maps showing the geographic distribution of soil and sand particles in the atmosphere. The presence of such maps makes it possible to implement goal-oriented protective measures over large territories and to rationally distribute capital investments for their realization. The most important part of these measures are protective tree plantings.

In turn, the multi-zonal systems of satellite information combined with selected aerial photos facilitate better determination of the state of plantings damaged by pests, diseases and natural disasters, and also aid in monitoring forest management activities. The fulfillment of this work is done in a very short time, which is very important because it creates a real possibility for quickly taking any necessary measures.

Photographs taken from space also make it possible to evaluate the watershed role of forests. It is possible to determine the water reserves over large territories and to control the state of the snow covering. One other important problem is also solved with the aid of space means -- recording the water balance of large regions, which must be considered particularly in performing water and forest reclamation work over extensive territories.

We may cite many specific examples of using the advantages of space photographs in the interests of agriculture. Thus, the scheme of land use and environmental protection of the Mangyshlak peninsula was developed with the aid of photos taken from space. Since the Mangyshlak region is located in a semi-arid dry zone, the "bottleneck" for the development of agricultural production here is the shortage of fresh water. The photos taken from space showed that within the margins of the studied territory, there are sections with overall area of 2,000 square kilometer which are promising for obtaining fresh ground water from shallow wells. The operational reserves of fresh water are approximately evaluated at 3,500-4,000 million cubic meters.

The scientists of Turkmenia, using the data from space photographs, have developed a series of geobotanical maps for the "Yerbent" sovkhos, whose land area comprises around a million hectares. The maps represent in detail the location of natural fodder crops, the quality and seasonality of the herbage, and the fodder reserves. The organization of the sovkhos grazing management received scientific substantiation.

Based on the data obtained from space, the Krasnodar Scientific-Research Agricultural Institute is implementing measures to combat soil erosion over an area of several thousand hectares.

Using space technology, the specialists at the Institute of Space Research on Natural Resources of the Azerbaijan SSR Academy of Sciences have performed a great volume of work on studying the soil-vegetation and agricultural resources of their republic. Specifically, they have developed an extensive program for studying and developing the soil in the Caspian coastal section with area of over 400,000 hectares. This will make it possible in the next few years to utilize these soils for agricultural cultures and to create livestock raising farms on the basis of the natural fodder crops.

All these examples are evidence of what broad application the data from remote earth sensing obtained with the aid of space technology have in solving scientific problems and production tasks facing agriculture and the entire agro-industrial complex of our country.

Extensive experience in utilizing space information has been accumulated by Soviet specialists also in other spheres of economic management activity. Thus, geological deciphering of space images has shown that relatively large-scale photos are effective for structural geological and geomorphological mapping, while small scale representations open up the possibility of studying the structure of the earth's crust and its deep structure. For example, the photos of the West Siberian Depression were used to detect large deep-seated breaks which were hidden under a kilometer-deep cover of loose young formations. This made it possible to significantly alter the notions about the distribution of petroleum and gas deposits.

The view from space has shown principally new structures which had not been previously studied or charted. These are primarily the so-called ring structures. As it turned out, they were associated with the deposits of numerous minerals. An example of this may be the study of the Okhotsk-Chukotsk volcanic belt, which extends for 2,000 km. This is a very rich storehouse of minerals. The photos taken from orbit made it possible to clearly discern numerous ring structures, often with a diameter of several tens of kilometers, which determine the location of numerous ore formations of volcanic origin. They are located around the rim of the ancient volcano mouth. Sections were noted in which detailed survey work was to be performed. At the very beginning, this work yielded positive results.

Extensive work has also been performed on space photo-geological mapping of the Baykal-Amur Main Line zone. This has helped in selecting the true direction of geological surveys for a wide range of minerals found near the BAM. A direct dependence has been established between the "rings" and rich deposits of iron ore in the Angara River basin.

Satellite observations of the state of the Kara-Bogaz-Gol Bay on the Caspian Sea have also been rather effective. After building of a dam, this bay has become a lake. The study of its dynamics has great significance. If we were to utilize standard methods, a large number of ground stations or expensive airplane fly-overs would be necessary. It has turned out that sequential analysis of satellite photos with a periodicity of only once a month is sufficient for monitoring the state of Kara-Bogaz-Gola. This yields an economic effect of around 400,000 rubles per year.

Artificial earth satellites, manned space vessels and orbital stations have made it possible to collect rather valuable, and sometimes also unique scientific information about the ocean. The study of marine currents and the biological productivity of the World Ocean is of particular interest. It has been computed that for industrial development of the entire oceanic aquatorium, it is necessary to perform a regular search over an area of 150-200 million square kilometers. This task can only be accomplished through space methods.

Today there is no doubt in anyone's mind that the ever-increasing needs for evaluating the reserves and planning the utilization of the Earth's natural resources, as well as the need for global study and monitoring of the state of the environment, may be ensured only with the aid of rocket-space technology. Therefore, at the present time we are faced with the task of studying the Earth and the environment as an integral whole with the creation of complex, efficient, permanently effective systems which include other means of information gathering aside from the space sector. In this case, the problem of efficient information processing is particularly acute.

In the sphere of practical application of materials from long-range sounding, the Soviet Union is implementing broad international cooperation on a multilateral (within the framework of the "Interkosmos" program) as well as on a bilateral basis. Agreements have been concluded with all the countries of the socialist alliance. They are jointly solving scientific-methodological questions of utilizing materials of long-range sounding and creating technical means for obtaining these materials. The flight program of Soviet satellites includes the regular photographing of the territory of the socialist countries at their request.

The development of cosmonautics also engenders new technical directions, which in time may become strong sectors of space production. At present in orbit there is a broad search for the possibilities which space affords us as a peculiar technological medium.

The fact is that space is capable of providing particularly favorable conditions for certain production processes. Thus, metals which stubbornly refuse to fuse in earth laboratories fuse very well in space and attain new and unique properties. For example, the alloy of aluminum with tungsten, which can only be obtained in space, has such properties as infusibility, heat resistance and light weight, all at the same time. The significance of such alloys, particularly for the aviation and space industry, can hardly be overestimated. Specialists believe that it is possible to create on the order of 400 new alloys in space which would be capable of revolutionizing all of industry. Among these are many semiconductor and optical materials which represent alloys consisting of three or more components.

Under earth conditions it is impossible to separate the blood protein albumin into its components, except by chemical means. Every living creature perishes in the attempt. In space, however, it has been possible to separate albumin into five fractions, without disrupting the living structures, using the method of electrophoresis. This makes it possible to optimistically view the prospects for producing high purity biological substances, prepares for diagnosing illnesses, curing certain heart diseases, overcoming tissue incompatibility, solving problems of oncology and other purposes under conditions of weightlessness.

Soviet scientists, having at their disposal orbital manned stations and various improved installations, have accumulated extensive experience in technological experiments performed in space and in obtaining materials with improved properties



under weightless conditions. Experiments on the program of space materials technology were also performed on board the orbital station "Salyut-7". In the next few years we will be witness to new space technological experiments of applied significance. We may expect that specialized technological orbital stations will be built, equipped not only with scientific-research, but also with production installations. All this will lead to a closer tie between space research and the needs of the national economy.

In speaking of national economic programs, we must also point out the prospects of space energetics. The mastery of the boundless and ecologically "clean" energy of the Sun will become man's greatest achievement. Already today there are project designs on space systems for collecting solar energy, concentrating, transforming and transmitting it to Earth on a scale commensurate with the present total energy consumption of the industrially developed countries. These projects will be realized in the next few decades.

We must note that the mechanism of transforming solar energy into electrical energy is in many ways still unclear. In recent years, Soviet scientists have developed a new photoeffect theory. This enstills the hope that the effectiveness of solar batteries will be sharply increased. Then solar electrical space stations will become profitable in the highest degree.

Of course, the implementation of programs on such a scale will require the further development of space systems and means of placing them into orbit. In the sphere of manned complexes, besides long-term stations and transport apparatus, the need is arising for small highly maneuverable apparatus for installation work, "orbit to orbit" flights, and individual descent of cosmonauts to Earth. As concerns the further development of Earth to orbit transport systems, in the opinion of specialists the most economical means will be booster rockets with a one-time useful mass of over 100 tons based on two-stage systems with reusable second as well as first stage.

However, the role of modern cosmonautics is not limited to the solution of specific applied scientific problems. The methodological and design-technological achievements of leading sectors of engineering associated with space research are becoming the property of the industry as a whole.

Cosmonautics represents an integrated set of disciplines which include hundreds of traditional and new branches of science, technology and production which rest on all the achievements of modern scientific-technical progress. At the same time, space research stands out objectively as a mighty lever for this progress, having a huge effect on the development of scientific and technical thought, stimulating the growth of technical sciences and the emergence of more and more new design and engineering developments, and accelerating the emergence of sectors of production to which our future belongs.

Space, with its unprecedented high demands for product quality, for purity of materials, and for operational reliability of apparatus, forces industry today to rise to the level which it could not achieve yesterday, and to improve and modernize all sectors of production. Thanks to space research, for example, a class of precision has been achieved which was simply unthinkable 20 years ago.

In speaking of phenomena and processes which are characteristic for the reaches of space and other heavenly bodies, it is customary to use the word "super" -- superhigh pressure, superlow temperatures, superdeep vacuum. Under such conditions, all ordinary materials change their properties, and often their operational characteristics deteriorate significantly. This explains the increased interest of modern science in studying the threshold situations in materials and mediums which arise under the influence of dynamic overloads, irradiation, shock waves, and other factors. The new technology, the new instruments and assemblies created for satellites, automatic interplanetary stations and space ships are finding ever more effective application in the everyday practice of enterprises manufacturing ordinary "earth" production. The prospects for utilizing the achievements of cosmonautics are boundless, like space itself.

And, of course, no matter how great the practical return of space flights, as before their huge role in the process of learning about the world around us, about the Solar System and the entire Universe, and of understanding the space phenomena affecting the life of our planet will remain paramount.

Man's penetration into space is a grandiose program whose results can truly be evaluated only in the future.

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## USSR-VIETNAM SATELLITE DATA LINK

Moscow PRAVDA in Russian 26 Jun 84 p 5

[Article by L. Chaurov]

[Excerpt] An interesting experiment is ending today. It has been in progress in the Soviet Union and Vietnam simultaneously. During the past few days, persons in a video-terminal room of the International Center of Scientific and Technical Information (MTSNTI) have been able to take part in a transcontinental or, more correctly, a 'trans-space' hookup between Soviet and Vietnamese scientists.

Remote access to MTSNTI data bases from this distant country was made possible via a Soviet "Statsionar" communications satellite.

"In addition to MTSNTI, the Central Institute of Scientific and Technical Information in Vietnam and the All-Union Scientific Research Institute of Applied Automated Systems in the USSR are providing support for this large-scale experiment over the Hanoi-space-Moscow route," related Yu. Gornostayev, a Soviet specialist. "Incidentally, a similar experiment has already been conducted over a Moscow-space-Havana route. We are thus approaching, step by step, the creation of a network of centers for automatic exchange of information among countries of the Council for Mutual Economic Aid."

I saw equipment manufactured in member-countries of the council operating in well-coordinated fashion. Information contacts can be reliably maintained with this technology. It includes a Bulgarian electronic system, "ESTEL"; a Hungarian apparatus called "Videoton"; and a computer made at the "Robotron" complex in the German Democratic Republic (GDR).

"What kinds of information have our Vietnamese friends been requesting?" said Horst Kosche, an MTSNTI associate from the GDR, stating one of my questions more precisely. "They are seeking information in the nuclear-physics data base INIS, for example."

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## SHIPBOARD SATELLITE COMMUNICATIONS EQUIPMENT EXHIBITED

Riga SOVETSKAYA LATVIYA in Russian 19 Jul 84 p 4

[Article by V. Ryndin]

[Abstract] The article provides information on features of Soviet developments that were being shown in an exhibition, "New Communications Apparatus and Equipment", which opened recently at the USSR Exhibition of National Economic Achievements in Moscow. Particular attention is devoted to equipment intended for the international "COSPAS-SARSAT" system for locating ships and airplanes in distress and for other satellite-aided communications systems.

This equipment includes an emergency radio buoy, the "COSPAS-ARB", and a shipboard radio set, the "Standart-A". Among the elements of the "COSPAS-ARB" are radio beacons operating on a satellite communications channel, and a short-range homing station, which make it possible to shorten search time and expand the detection zone of an object substantially. This buoy is said to ensure precise identification of ships and to provide information on a disaster's coordinates with precision as high as a minute of angle, as well as information on the nature of the disaster. The "COSPAS-ARB" can also be used by persons working in areas that are remote and difficult to reach. The "Standart-A" is intended for ship-to-shore communications via the geostationary satellites "Immarsat" and "Gorizont". This set enables ships to communicate with practically any user regardless of weather conditions, it is claimed.

Mention is made also of a shipboard radio set called "Angara". It is produced in two variants: the "Angara-RBI", which is intended for seagoing vessels, and the "Angara RA", which is intended for floating power plants and river vessels of the "Meteor" and other types. The "Angara" is described as a compact, fourth-generation radio set with a memory and a microcomputer, which permits the automatic scanning of eight call channels. The power consumption of the "Angara" is low, and it is capable of transferring automatically to battery power supply if necessary.

A photograph is given showing the "Standard-A" radio set, including its antenna.

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## SPACE ANTHROPOECOLOGY CONFERENCE HELD IN LENINGRAD

Leningrad LENINGRADSKAYA PRAVDA in Russian 7 Jun 84 p 2

[Text] The space age, which began with flights of Soviet satellites and cosmonauts, has afforded unprecedented possibilities for studying from orbit the interrelationship of natural phenomena for the purpose of forecasting and managing the biosphere and the wellbeing of humans on a global scale. This was a topic of discussion at the second All-Union Conference on Space Anthropoecology, which ended yesterday. The three-day conference was held at the House of Political Education of the Leningrad Oblast Committee of the Communist Party. Its participants were cosmonauts, specialists in space technology, geophysicists, medical specialists and representatives of many other sciences.

Papers and reports that were presented emphasized that in recent years, the USSR Academy of Sciences' scientific council on problems of the biosphere, in collaboration with other organizations, has done a great deal of work on the further focusing of numerous scientific directions on the main problems of space anthropoecology. Cosmonaut-researchers are making a large contribution to the study of the Earth. Results of their work are being introduced into practice and into scientific research that is being done in other fields of knowledge. USSR Pilot-Cosmonaut A. A. Leonov spoke in particular about the training of future cosmonaut-researchers and specialists in the study of Earth from space.

The conference examined the question of organizing a station in Leningrad for the study of the biosphere from space. It would pursue basic research of biosphere processes in the city and its suburban areas.

FTD/SNAP

CSO: 1866/197



CONFERENCE NOTES HEALTH APPLICATIONS OF SPACE PHOTOGRAPHY

Frunze SOVETSKAYA KIRGIZIYA in Russian 10 Jun 84 p 3

[Abstract] The short article reports on the conclusion of the second All-Union Conference on Space Anthropol ecology, which was held in Leningrad.

V. P. Kaznacheyev, member of the USSR Academy of Medical Sciences, is quoted in regard to the objects of study and goals of this new scientific direction. He called space anthropol ecology a science of human health and human population in terrestrial and nonterrestrial conditions of space, and said its main task is the study of the biosphere and of near and distant space as an environment which determines the development of the present and future generations of people. Kaznacheyev noted that one practical application of the new science involves space 'cartography' of the health of the Soviet population. Data on the health and longevity of people in entire geographical regions are coordinated with space photographs. It is claimed that this makes it possible to draft practical recommendations for improving ecologic conditions on Soviet territory.

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ENERGY-ACTIVE ZONES IN NORTH ATLANTIC AS MANIFESTATION OF INTERANNUAL  
VARIABILITY OF RADIATION BALANCE

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 1, Jan-Feb 84  
(manuscript received 6 Sep 83) pp 3-15

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[Abstract] In addition to a description of the spatial influence of energy-active zones in the ocean, this article gives a statistical analysis of the observational data which makes it possible to represent the field of radiation balance anomalies in terms of natural orthogonal components (empirical orthogonal functions) and thereby tie in data from continuous satellite measurements and shipboard measurements in energy-active zones. The statistical analysis gave not only the location of zones of considerable variability of the radiation balance, but also the representative dimensions of these zones over the pertinent area of the North Atlantic. The most important result of this study is the conclusion that the use of time series of satellite measurements is highly promising. The main problem which requires further study is gaining a comprehension of the cloud cover feedback mechanism and the components of the radiation balance of the ocean surface-atmosphere system. A necessary condition for carrying out further investigations is determination of the diurnal variation of radiation balance components by a reasonable combination of data from geostationary and polar-orbit satellites. There can be further refinements in the computation scheme for the reduction of satellite measurement data to the level of the earth's surface. The materials in the article are indicative of the great effectiveness of joint use of data from satellite and shipboard observations for studying interaction between the atmosphere and ocean. Figures 4; tables 2; references 14: 13 Russian, 1 Western.  
[93-5303]

## SOME STATISTICAL CHARACTERISTICS OF ATMOSPHERIC OPTICAL THICKNESS IN VISIBLE SPECTRAL RANGE

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 1, Jan-Feb 84  
(manuscript received 14 Jul 83) pp 33-37

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[Abstract] Remote determination of the brightness coefficients for the earth's surface from artificial earth satellites in the visible spectral region is discussed. This requires a series of measurements of brightness of the surface-atmosphere system ensuring simultaneous determination of atmospheric and surface parameters in each specific case. The method was described by V. V. Badayev, et al. in IZV. AN SSSR: FAO, Vol 14, No 10, pp 1022-1030, 1978. The method is based on brightness measurements in several parts of the oxygen band  $0.76 \mu\text{m}$ . Such measurements are used in determining the vertical profile of atmospheric optical thickness  $\tau(\lambda_0, z)$  and the surface brightness coefficient in the wing of the band  $\lambda_0 = 758 \text{ nm}$ . For determining  $\tau(\lambda_k, z)$  in other parts of the spectrum  $\lambda_k$ , a priori information is used in the form of the statistical characteristics of the spectral structure of optical thickness (mean distributions  $\bar{\tau}(\lambda_k, z)$  and autocorrelation matrices  $B_{\tau\tau}(\lambda_k, \lambda_l, z)$ ). In this article the author obtains the statistical characteristics of total optical thickness  $\tau(\lambda_k)$  on the basis of measurements of atmospheric transparency obtained at six points in the USSR during 1972-1975 in six parts of the spectrum ( $\lambda_k = 0.34, 0.37, 0.46, 0.53, 0.57, 0.63 \mu\text{m}$ ). In the materials and examples presented here it is shown that it is desirable to make such an analysis for different climatic zones and seasons for defining the general patterns and possible differences in the spectral structure of optical thickness. It is concluded that the most important factor determining variations in optical thickness in the interval  $0.34\text{--}0.63 \mu\text{m}$ , ensuring high correlation in different parts of the spectrum, is the finely disperse aerosol fraction. It was found that the first two eigenvectors of the autocorrelation matrices  $B_{\tau\tau}(\lambda_i, \lambda_k)$  determine 98% of the dispersion of optical thickness. This made it possible to discriminate the two principal components of optical thickness variations. Figures 2; tables 2; references 8 (Russian).  
[93-5303]

## SEISMOTECTONIC NATURE OF SOME ANNULAR PHOTOANOMALIES REGISTERED BY REMOTE METHODS

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 1, Jan-Feb 84  
(manuscript received 13 Apr 84) pp 38-40

POPKOV, V. I., Kazakh State Scientific Research and Planning Institute of the Petroleum Industry, Shevchenko

[Abstract] The seismotectonic origin of the annular formations observed on space photographs is examined. As early as 1968 it was postulated that structures of the central type are formed under the influence of wave stresses forming during sporadic release of energy from the earth's deep layers, with longitudinal waves being the principal carrier of this energy. A longitudinal wave, encountering density interfaces, is reflected with the formation of longitudinal and transverse waves. This leads to a chain of events with a superposing of stresses. The resulting dilatational stresses exceed the compressional stresses, finally giving rise to the formation of disk-shaped fissures in the crust. The freeing of energy during earthquakes also results in the formation of a system of radial fissures caused by considerable dilatational stresses in a tangential direction and annular fissures forming as a result of dilatation in the direction of the excitation focus due to elastic restoration of the initially highly compressed medium. The projection of these systems of fissures onto the earth's surface is registered by remote methods in the form of annular or concentric structures with radial faults complicating them. The center of annular structures sometimes is associated with the points of intersection of faults. Many of these annular structures are not expressed in the deep structure nor in geophysical fields, also evidence of their seismotectonic nature. Figures 2; references 10 (Russian).  
[93-5303]

UDC 551.25:528.77:550.814+629.78(574.1)

## PREDICTING FRACTURING ZONES IN CASPIAN DEPRESSION SUBSALT DEPOSITS ON BASIS OF SPACE INFORMATION AND GEOLOGICAL-GEOPHYSICAL DATA

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian, No 1, Jan-Feb 84  
(manuscript received 19 Jul 83) pp 41-50

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[Abstract] An investigation of the region of the Astrakhan arch for interpretation of space photographs at different scales taken at different seasons, in comparison with data from seismic prospecting, electric prospecting and deep drilling, made it possible to define several zones of

increased fracturing extending in a submeridional direction and oriented almost perpendicular to the strike of the structure. These zones were detected not only within the limits of the Astrakhan gas condensate deposit, but also in the south in a number of local uplifts. Drilling data reveal that precisely in these zones Paleozoic calcareous deposits are characterized by improvement in the collector properties of the rocks, especially their filtration properties, and increased fracturing. The first experience in using data from remote surveys of the surface in combination with geological-geophysical data for predicting zones of increased fracturing demonstrated that it is quite objective and the method is applicable in other parts of the depression. Photographs with a regional or continental level of generalization were used because these best reveal the peculiarities of structure of the subsalt formations. In the eastern part of the Caspian Depression there are at least five principal quite extensive systems of lineaments or lineament zones (submeridional, northwesterly, northeasterly, east-southeasterly and sublatitudinal). The study revealed that in calcareous rocks, having a complex structure and marked facies changes, it is possible to interpret zones of propagation of high-capacity collectors. The proposed drilling of a deep parametric borehole may confirm effectiveness of the method. Figures 4; tables 1; references 6 (Russian).  
[93-5303]

UDC 634.4:629.78

# METHOD FOR INTERPRETING SOIL COVER OF PLOWED FIELDS USING SPECTRAL BRIGHTNESSES MEASURED FROM SPACE PHOTOGRAPHS

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 1, Jan-Feb 84  
(manuscript received 6 May 83) pp 51-57

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[Abstract] A method for soil interpretation of space photographs taken using the "Fragment" system from the "Meteor" artificial satellite, together with field and laboratory data, is described. The best photographs for this purpose are those taken in the spring or autumn when most of the territory is free of vegetation. The following stages are involved: discrimination of plowed fields not covered with vegetation; measurement of spectral brightnesses of plowed fields; computation of statistical evaluations of brightnesses and their distribution; "clustering" of brightness fields; analysis of spatial distribution of cluster elements; field measurements of coefficients of spectral brightness and taking of soil samples; laboratory investigations of samples; geographic interpretation of the spatial distribution of elements of the defined clusters. Plowed fields are discriminated quite reliably on photographs taken in the IR-range  $\lambda = 0.8-1.1 \mu\text{m}$  on the basis of the criterion of minimum relative brightness. Since the interpretation method is dependent on the peculiarities



of the landscape and its components the method is described here using specific cases. The method was used in the interpretation of soils over an area of 20,000 km<sup>2</sup> differing with respect to humus content in the range 2-3.5%. The spectral brightnesses of the cultivated horizon determine the relative quantitative characteristics only in a case of their comparability, when the main difference in the upper horizon is caused primarily by one factor. Such a comparison can be made within the limits of soil provinces. If the characteristics of the cultivated horizon are dependent on many factors with an approximately equal influence of two or three of them, the differences in spectral brightness will result in ambiguity of interpretation. Figures 4; tables 1; references 2 (Russian). [93-5303]

UDC 551:629.78:631.4

#### SPACE OBSERVATION OF LATITUDINAL CHANGES IN VEGETATION COVER

Moscow ISSLEDOVANIYA ZEMLI IZ KOSMOSA in Russian No 1, Jan-Feb 84  
(manuscript received 19 Jul 83) pp 58-61

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[Abstract] A study was made of latitudinal changes in the state of the vegetation cover in the USSR on the basis of space photographs. Multizonal photographs were taken with a MKF-6 camera during the autumn (16-21 September). Comparative observations of different territories south of 65° were made. During this season there was a gradual change in the external appearance of the landscape associated with the maturing and harvesting of agricultural crops and transition to autumn coloring of forests. The phase of this process changes with latitude and this should be manifested in a latitudinal variation of spectral brightness changes. A comparison of observations made over these areas with equal solar altitude required use of a standardization procedure proposed by the author earlier in AEROKOSMICHESKIYE ISSLEDOVANIYA ZEMLI, Moscow, Nauka, pp 185-192, 1978. The survey data were used in forming a randomized sample of spectral brightness measurements of areal features measuring over 1 km<sup>2</sup> in six spectral zones; the sample included about 500 features. The measured brightness values in each spectral zone were normalized relative to the brightness sum for all six zones and it was then possible to ascertain the spectral luminosities associated with the dynamics of the state of the earth's surface as a function of latitude. Figure 1 in the text shows the spectral variation of a linear regression coefficient which characterizes the mean change per degree of latitude; the shape of the curve agrees with the shape of the spectral brightness curve of vegetation. With movement from north to south there is a general tendency to a decrease in absorption in the main chlorophyll band and a corresponding increase in absorption in the IR region associated with the yellowing and dessication of vegetation. This and other differences in growing season phases observed from space make it possible to formulate a spatial-temporal model of development of the vegetation cover. When

agroclimatic characteristics of different regions are taken into account it will help in predicting the effectiveness of agricultural production. Figures 2; references 10: 9 Russian, 1 Western.  
[93-5303]

UDC 551.49:629.78

EVALUATING EFFECTIVENESS OF USING SPACE INFORMATION IN SPECIALIZED  
HYDROGEOLOGICAL RESEARCH

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 1, Jan-Feb 84  
(manuscript received 11 May 83) pp 68-72

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[Abstract] At present, computations of the economic effectiveness of use of space photographs is limited to definite special tasks when it is possible to estimate expenditures on making corresponding investigations by the traditional method and when the required information is obtained from photographs. After a general discussion of the problems involved and the most probable immediate goals in this field, details are given on the expenditures involved in the compilation of hydrogeological maps by the old and new methods. The cost of work on medium-scale hydrogeological surveys of open regions in foothill areas, for example, averages 30.8 rubles/km<sup>2</sup>; the final production of a hydrogeological map requires 2 or 3 years. The procedures developed at the Institute of Water Problems for the hydrogeological interpretation of space photographs include the following: collection and processing of archival hydrogeological data for the investigated region; preliminary interpretation of photographs; aerovisual observations of investigated region; limited on-the-ground reconnaissance; office processing of all data. The comparative cost for this type of work is 12.5 rubles/km<sup>2</sup>. The map, by comparison, is produced in 6-8 months. Taking into account that the user of space video information receives this material without cost, the savings in money and work amount to a factor of 2.5-3.5. It is believed that even greater economies can be realized in estimating the natural reserves of ground water when space photographs are used. The method developed at the institute makes it possible to use photographs, without special reconnaissance and geophysical work, to determine the thickness of sediments in intermont basins in arid regions and thereby form a preliminary estimate of geological reserves of ground water. References 9 (Russian).  
[93-5303]

ECONOMIC EVALUATION OF SPACE SURVEY MATERIALS USE IN LAND IMPROVEMENT  
ENGINEERING FIELD WORK

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 1, Jan-Feb 84  
(manuscript received 21 Apr 81, after revision 23 May 83) pp 73-78

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[Abstract] The effectiveness of use of space survey materials in the planning of land improvement systems is evaluated. Virtually the entire territory of the USSR is now covered by space photographs. Maps compiled from space photographs are more informative than those compiled by traditional methods. Table 1 gives the reliability of identification of different natural and artificial features on such photographs. The data in this table and other materials show that a space survey considerably enhances the reliability of medium-scale specialized mapping in comparison with the traditional methods of surface engineering field work and aerial survey. The article gives a method for calculating the hypothetical economic effect from use of space survey data for engineering field work in planning land improvement measures for a specific territory. The method essentially involves a determination of the comparative economic effectiveness of the traditional method and the method involving use of space photographs. It is shown that the use of the latter not only gives a higher reliability, but it also results in an earlier completion of the work and accordingly an earlier increased yield of crops from the improved lands, not to mention a long-range yield increase resulting from superior engineering field work made possible due to availability of a more reliable cartographic base. No proper land improvement scheme can be devised by investigation only of the immediate area involved. Such planning requires a sound understanding of a much more extensive area; the use of space photographs makes this effective and economical. In making the favorable evaluations presented in this article no allowance has been made for the costs involved in operation of the space system used for obtaining and processing the images. Tables 4; references 22 (Russian).  
[93-5303]

## PREDICTING OPTICAL IMAGE DISPLACEMENT VELOCITY IN SURVEY OF EARTH'S SURFACE

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 1, Jan-Feb 84

(manuscript received 25 Apr 83) pp 79-85

BATRAKOV, A. S.

[Abstract] The quality of images from space is determined to a considerable degree by the displacement of the optical image relative to the film or photosensitive material during exposure. The principal factors responsible for displacement of images relative to the photomaterial are translational movements of the survey camera relative to an observed surface and changes in its spatial orientation. The velocity of image movement is influenced by the angular position of the camera, curvature of the earth's surface and rise of points in the survey region above the level surface. Some authors have only taken a few of these factors into account. This may be adequate in special cases, but such an approach is limited because there can be no guarantee of the accuracy of prediction of image displacement velocity. The author has therefore formulated a general model for determining the displacement velocity of an optical image over the field of the photosensitive material with an arbitrary orientation of the survey camera in space and with translational and rotational movement in three coordinate axes. Particular attention is given to the systematic errors which arise when the terrestrial ellipsoid is replaced by a sphere. With use of a spherical model the absolute deviations of the normalized longitudinal component of image displacement velocity fall in the range from  $-0.0127$  to  $+0.0208$ , assuming a zero value with an argument of latitude about  $40^\circ$ . These deviations are attributable to systematic errors in determining survey altitude and velocity. With a decrease in the mean orbital altitude the errors increase, whereas with an increase they decrease. The normalized values of the transverse component of optical image displacement velocity do not exceed  $0.066$ , whereas the systematic errors with conversion to a spherical model do not exceed  $0.001$ . Accordingly, a spherical model is unacceptable due to considerable systematic errors if the accuracy in predicting optical image displacement velocity must not be worse than 1-2%. Figures 3; tables 1; references 9 (Russian).

[93-5303]



## METHODS FOR DETERMINING ATMOSPHERIC OPTICAL PARAMETERS USING RESULTS OF SPACE SURVEY OF EARTH'S SURFACE

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 1, Jan-Feb 84  
(manuscript received 22 Jun 83) pp 86-91

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[Abstract] The simultaneous use of a so-called "track" spectrometer with a high spectral resolution and a scanner in the experiment "Bolgariya-1300-II," together with high-quality metrologically sound information obtained in the course of this experiment, have made it possible to develop new methods for determining atmospheric optical parameters. Two such new methods are considered. The first is based on the fact that one and the same sector of the earth's surface, surveyed in different spectral ranges, has different spatial contrasts and therefore a change in these contrasts carries information on atmospheric optical properties. In order to validate this approach a special study was made to determine how a change in the brightness of features on the earth's surface in different spectral ranges exerts an influence on their spectrum of spatial frequencies. In the second method, use is made of multispectral track information obtained in absolute brightness values. The availability of such information and a knowledge of the albedo of some surface sectors make it possible to determine atmospheric optical properties on the basis of brightness changes of standard objects. In the first method it is clear that surface sectors without sharp brightness differences are described well by the approximation of small variations of spectral coefficients and even the presence of small water surfaces (lakes, rivers), whose brightness in the IR range is close to zero, exerts no significant effect on the spectral ratio curves. In general, this method is sensitive to atmospheric optical parameters. With respect to the second method, it is shown that by knowing the albedo of standard surface sectors intersected by the track it is possible to ascertain some atmospheric optical parameters. As standards it is possible to use water bodies, highways and other reference features which can be identified after referencing the track to a scanner photograph. Figures 3; references 5 (Russian).  
[93-5303]



## TECHNOLOGICAL APPROACH TO AUTOMATION OF SPECIALIZED PROCESSING OF SURVEY DATA

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 1, Jan-Feb 84  
(manuscript received 11 May 83) pp 92-100

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[Abstract] The capability of a system to solve its assigned tasks at stipulated times is dependent on the proper choice of the structure of the automated data processing system. Experience in specialized processing of photographs for forestry purposes has shown that specific processing problems involve a great diversity of factors exerting an influence on their solution (examples are cited). The solution of any such problem requires the development of a specific technology regulating the processing methods and apparatus, their interrelationship and sequence of use, and also the degree of man's participation in solution of this problem, ranging from preparation of the initial data to obtaining the results. The technological approach to the automation of specialized processing of photographs makes it possible to increase the quality of organization of such processing and makes more reliable the choice of methodology and programs for each problem. The article discusses the choice of the technical tools and methods for the new technologies and choice of structure of the complex. Two extremal variants of complex structure are examined: Structure A, a universal single-channel complex for operation with all technologies and Structure B, a specialized complex consisting of  $n$  technological lines, each of which is adapted to a definite technology. It is concluded that the decisive factor in the choice is the presence or absence of high-speed processing facilities at the time of introduction of  $n$  technologies. In the planning of new complexes it is desirable to select structure A as being more economical. In organizing systems from available equipment preference must be given to structure B. The All-Union Association Lesproyekt has an experimental automated system for the processing of aerospace forestry data. There are two technological lines: 1) PHOTOGRAPH-DATA line used in determining evaluation indices for forests over an extensive zone on the basis of aerospace photographs; 2) PHOTOGRAPH-MAP line for automated preparation of plans and maps for use in forest management on the basis of aerial photographs. The mentioned "technologies" are briefly described. Figures 2; tables 1; references 5 (Russian).  
[93-5303]

## CHOICE OF CARTOGRAPHIC PROJECTION FOR SPACE SYSTEM DATA BANK USED IN STUDYING NATURAL RESOURCES

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 1, Jan-Feb 84  
(manuscript received 2 Mar 83) pp 101-109

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[Abstract] The interpretation of photographs obtained using space systems for the study of natural resources is accomplished by a comparison of a television panorama obtained from a space vehicle and specialized maps contained in an earth resources data bank, a data retrieval system which includes a computer and a magnetic memory system. Such maps must be in a cartographic projection which takes into account the particulars of the space survey and which at the same time has the minimum possible level of characteristic distortions. The panoramas received from the spacecraft must be transformed into this projection. Topographic maps compiled at a scale of 1:500,000 or larger are in a Gauss-Kruger projection with a 6° zone having equal-angle properties and a uniformity of scale along the central meridian of this zone. If this projection was used in developing the data bank matters would be simplified, but then difficulties would arise in its use because the space vehicle orbit is inclined to the equatorial plane at an angle different from 90° and while moving along the ascending or descending branch the vehicle would repeatedly intersect adjacent meridian zones. This would give rise to a great many difficulties in data bank structure and use. A solution for this problem is proposed. The terrestrial ellipsoid can be divided into zones oriented along several space vehicle tracks on the surface and having such a width that the zone of coverage of any panorama received in a communication contact is situated in only one zone and in the coordinate zone corresponding to it a system of plane coordinates is stipulated which determines some oblique projection. An example of use of the proposed method is presented. The USSR was divided into zones with a width of 760 km and a length of 4,910 km. The axial line of each zone for the most part coincides with a nominal orbital track of a space vehicle passing through a point with stipulated coordinates. With any longitude of the ascending node of the space vehicle orbit the corresponding zone of panorama coverage will be situated only in a single zone. The proposed oblique equal-angle projection ensures mapping within the limits of one zone with length distortions not greater than 0.166%, which fully corresponds to the standard for map compilation. Figures 2; references 6: 3 Russian, 3 Western.  
[93-5303]

## SPACE POLICY AND ADMINISTRATION

### IZVESTIYA ATTACKS U.S. SPACE POLICY

Moscow IZVESTIYA in Russian 2 Jun 84 p 5

[Article by G. Zhukov, professor, doctor of technical sciences, sector chief, Institute of World Economics and International Relations, USSR Academy of Sciences: "To Prevent the Militarization of Space"]

[Text] In the eyes of the entire world, the present administration in the United States of America is preparing to commit a heinous crime against mankind: it intends to convert space into an arena for an unchecked arms race. R. Reagan has pronounced intensive activity in this area to be an important goal of the United States' national policy. On 6 January 1984, the U.S. president sanctioned Directive No 119, which orders the beginning of the implementation of an expanded scientific research program for the creation of a broad-scale space antimissile system. As is known, Reagan first came forth with the call for the creation of such a system more than a year ago.

For this purpose, \$2.6 billion and \$3.1 billion have been allocated in the 1984 and 1985 fiscal years, respectively. A total of about \$26 billion is being proposed for the next 5 years. The total cost of the program for the creation of this system will cost the American taxpayer an astronomical figure: \$500 billion. What we are talking about here is the placement in near space (either completely or as separate components) of different types of directed-energy weapons (laser, accelerator).

At the same time, the development of the special ASAT antisatellite system, based on the F-15 fighter, is being accelerated in the United States on an intensified basis. The first test of this new space weapon, which is intended to destroy targets in Earth orbits, was conducted in January of this year. Deployment of this system is planned to begin by 1987.

The decision to build permanent orbital stations that was announced by Reagan is oriented on the use of space-based antimissile and antisatellite weapons. The use of spacecraft of the "Space Shuttle" type is also being contemplated for this purpose. The Pentagon is devoting special attention to the development and improvement of this reusable space transportation system.

The Pentagon is studying the possibility of using the electromagnetic pulse that appears in connection with a nuclear explosion at an altitude of 300-400 kilometers above the Earth's surface in order "blind" the enemy during the

infliction on him of an initial nuclear strike. This is intended to stop the transmissions of the enemy's radio and telephone stations, put telephonic and satellite communications, electronic control systems and computers out of order, and disrupt the activities of his air and ground transport.

No less intensively, the United States is improving the organizational structure of the agencies engaged in military space activities. Along with the space command, which has been operating in the U.S. Air Force since 1 September 1982, plans are being made to create a combined command of this type for all four armed services.

One cannot help but see that the United States' course toward the creation of a space antimissile system signifies a radical change in the military and political strategy of the United States' present administration that is based on the concept of "open antagonism" toward the USSR. According to a statement from the U.S. Department of Defense, this strategy is aimed at achieving "complete and indisputable military supremacy for the United States," "the restoration of America's leading role in the world," and "active opposition to the USSR in all regions of the world."

The United States' course toward the militarization of space is fraught with serious consequences. Here we are not talking simply about a quantitative enlargement of nuclear arsenals, but about the creation of qualitatively new military technology and the transformation of near space into a theater for military actions. The realization of the United States' military programs for space will lead to a sharp increase in the danger of a nuclear conflict that will be global in its destructive consequences.

It is no accident that a whole series of prominent American scientists, several military experts and public and religious figures are speaking against the plans for the militarization of space over which the United States' present administration is making such a fuss. A group of prominent American political and public figures recently announced the creation in the United States of the Coalition for the Peaceful Use of Space.

The United States' Democratic Party took into consideration the growing alarm of broad layers of American society over Washington's course toward the placement of a weapons system in space. In the draft of their pre-election platform on questions of national security, they included a demand for immediate cessation of antisatellite weaponry testing and development and rejected the placement of any type of weapon in space.

Progressive circles in the international community, many leading scientific research centers, and everyone who is concerned about the future of mankind are coming out against the militarization of space more and more actively. The Stockholm International Institute for the Investigation of Problems of Peace (SIPRI) is devoting much attention to this question. However, in the publications of this institute one encounters an insufficiently objective evaluation of the problem of preventing the militarization of space; namely, statements that the United States and the USSR bear equal responsibility for the lack of progress on this question. That type of statement lacks any basis, since the



responsibility for the present situation in this matter is solely that of the United States' present administration.

The realization of the United States' plans for the creation of space weaponry is incompatible with treaty obligations that have been accepted by it. Washington's militaristic aspirations are undermining the international law and order now existing in space and creating a serious obstacle for the adoption of further measures to limit the use of space for military purposes. And there is an acute need for the adoption of such measures, since the international agreements on space now existing do not directly prohibit the placement in it of military systems that do not fall under the definition of weapons of mass destruction.

From the very beginning of the practical conquest of space, the USSR and the other countries of the socialist concord spoke out and are continuing to speak out against the conversion of it into an arena for the arms race. These countries have participated directly in the conclusion of a whole series of international treaties and agreements aimed at limiting the use of space for military purposes. In particular, here we are talking about such important documents as the Treaty on the Prohibition of Nuclear Weapon Testing in the Atmosphere, in Space and Under Water and the Treaty on the Principles of Activities of States for the Investigation and Utilization of Space, Including the Moon and Other Heavenly Bodies, in which there is stipulated an important international legal obligation not to place in space objects carrying nuclear weapons or any other types of mass-destruction weapons.

Important provisions limiting the possibilities of using space for military purposes are also contained in bilateral Soviet-American agreements: the Treaty on Limiting Antimissile Defense Systems, an agreement on several measures in the area of limiting strategic offensive weapons (1972), and several other bilateral understandings from the 1970's. The realization of the United States' plans for the creation of space weaponry is incompatible with treaty obligations that have been accepted by it.

In the present situation, special importance is acquired by the USSR's proposal for the conclusion of the Treaty on Prohibiting the Use of Force in Space and From Space Toward the Earth, which was introduced in the United Nations in 1983. The Soviet Union, as is known, proposed to go farther than in 1981, when our country introduced in the United Nations a proposal for the conclusion of the Treaty on Prohibiting the Placement in Space of Weapons of Any Type.

The new Soviet proposal met with a widespread positive response at the 38th Session of the UN General Assembly. As a result of discussion of this Soviet initiative, on 15 December 1983 the UN General Assembly approved a resolution on preventing an arms race in space, the draft of which was introduced jointly by the socialist and nonaligned countries. The will of all the states that the investigation and utilization of space be carried out exclusively for peaceful purposes is confirmed in the resolution. The conferences on disarmament at the spring session, which was held in Geneva, proposed as the first order of business a discussion of the question of preventing an arms race in space and, in particular, the creation of a special working group on this question so as to begin discussions on concluding an agreement in this matter.



Another resolution approved by the 38th Session of the UN General Assembly contains a request for the UN Committee on the Use of Space for Peaceful Purposes to discuss at its regularly scheduled meetings the question of preventing the militarization of space. These decisions of the UN General Assembly were adopted by the votes of the overwhelming majority of the participants at the session, but the United States remained in isolation.

In striving to insure the realization of these UN decisions and achieve a radical solution to the problem of antisatellite weapons, the Soviet Union took upon itself, as an act of good will, the obligation not to be the first to place in space any kind of antisatellite weapon. This decision of the Soviet Union was one of the most important unilateral steps taken by it after its refusal to be the first to use nuclear weapons.

The Soviet initiative received extensive support throughout the entire world. The opinion that there is and can be no justification to refuse to work out the appropriate practical measures is becoming ever more widespread.

The Soviet Union considers the problem of banning the militarization of space to be one of the most urgent ones, and one that requires radical solutions. On our side, our country is prepared to make maximum efforts so that the sinister plans for transferring the arms race to space do not become reality. "In our opinion," announced K.U. Chernenko, the general secretary of the CPSU Central Committee and chairman of the Presidium of the USSR Supreme Soviet, "a policy directed at reliably guarding space against the placement of weapons there must become an obligatory standard for the behavior of states and a universally recognized international obligation."

The elimination of a military threat from space will create a favorable political atmosphere for extensive international cooperation in the matter of investigating and using this natural medium for peaceful and creative purposes. Space must be an arable area for diverse and fruitful worldwide cooperation, including cooperation between states with different social systems.

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## U.S. MILITARY SPACE POLICY ASSAILED

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 15 May 84,  
16 May 84, 18 May 84, 19 May 84

[Article by Vladimir Rykunov: "Washington's Space Goals"]

[15 May 84 p 4]

[Text] The ground suddenly gave a shudder and began caving in rapidly. On the surface of the American testing range in Rainier Mesa, Nevada there immediately appeared a crater 10 meters deep from which muffled cries for help could be heard. The fifteen people extricated from the hole by rescue teams were rushed to a hospital in Las Vegas, 150 miles away, some of them in critical condition. All work was stopped and a 24-hour radioactivity watch put in place. Three weeks later, all doctors' efforts notwithstanding, injured worker W.Meash died. The death certificate listed the causes of death as multiple injuries to internal organs and fractures suffered as a result of the cave-in.

Thus ended in tragedy another underground nuclear test conducted by the U.S.A. in mid-February of this year.

"But what relation does this accident have to the theme identified in the title of this article?" the reader may well ask.

Why, the most direct. According to information which has made its way into the American press, these tests are aimed at modifying and mastering small nuclear devices for use in space as anti-missile weapons.

The granite of the underground nuclear explosion chamber failed to withstand the Washington administration's urge to accelerate the development and implementation of a program to create "Star Wars" weaponry announced by President Reagan a year ago. The sad list of its casualties was begun by the catastrophe at Rainier Mesa.

### A Threat to the Entire Planet

Last year Edward Aldridge, deputy Secretary of the Air Force, declared with blimpish directness: "He who dominates space will dominate the world." The general thus bluntly expressed the long-known essence of U.S. imperialist policy which in regard to space, in Reagan's words, is "a dream of the future that offers hope".

To see his "dream" realized, reports the WASHINGTON POST, the U.S. president in January of this year signed directive No.119. In the words of official White House spokesmen, its goal is to achieve a level of technology that would allow the go-ahead to be given to develop and produce space weaponry capable of "repulsing an enemy attack". The directive gives a green light to a five-year plan of preparation for "star wars" at a cost of 27 billion dollars, a plan drawn up by a specially created commission headed by former NASA director J.Fletcher.

These nuclear-war advocates did what was expected of them. The skepticism and serious objections of many scientists notwithstanding, their report presented "an optimistic assessment of the newly-emerging technology, and from this position they came to the conclusion that a well-planned, multi-tier echelon system of defense against ballistic missiles could finally be made to work."

Within the framework of this ominous program the U.S. is developing a new generation of antimissile complexes, particularly for deployment in space. There are reports that hopes are being pinned above all on systems equipped with beam and laser "cannons" which are to bring down incoming rockets with powerful clots of energy. TIME magazine reports that E.Teller, their enthusiastic proponent, one of Reagan's science advisers and the "father" of the hydrogen bomb, recently declared: "I do not see the slightest reason why we should not exert all our will and in the shortest possible time not create such a defensive (italics mine - V.R.) weapon." After all, "it is entirely possible," adds the militant demagogue in a professorial toga, "that this will become a turning (!) point in history."

May we be permitted to ask: a turning to what? To thermonuclear war, the death of billions of people, the death of civilization and the earth itself?

The views of this rabid anticommunist today coincide perfectly with the hegemonistic philosophy of the trigger-happy warriors craving to aim their ray guns at the entire globe with themselves ducking retaliation under an antimissile shield. Having found fertile ground in the White House, these imperial plans are being implemented by way of new orders that will bring the military corporations billions of dollars in profits. And for many years to come, too, as long as it takes to create the comprehensive antimissile defense which allegedly is to become "the future that

offers hope". The space arm of this antimissile system, in the vision of its authors, will bring about the transition from the concept of "mutual guaranteed destruction" to the concept of "guaranteed survival". Solely for the United States of America!

The gist of these chauvinistic ideas is laid out in a military and political document authored by the ultrarightist organization "Heritage Fund" and entitled "High Frontier". It is from this paper that President Reagan extracted the basis of his scenario for "space wars". After the project's approval at the very top, the Fund's head, former Pentagon director of intelligence, retired lieutenant-general Daniel Graham joyously exclaimed: "We won't have to rely on paper treaties any more. We will keep the peace from a position of strength".

To ensure "survival" and "peace" the general is fighting for a system of hundreds of satellites - "trucks" and platforms - permanently orbiting the earth, armed with both "conventional" space weapons and a deadly assortment of high-energy rays capable of knocking down enemy missiles five minutes after they are launched. To do that the cosmic terrorists intend to use beams of light (emitted by hydrogen fluoride lasers) or of charged or neutral subatomic particles. There are other fantastic ideas for the project, such as using X-rays (generated by an atomic explosion and focussed by a laser) or the microwaves and electromagnetic impulses (EMP) that follow a nuclear blast.

One must be a cold-blooded cannibal to continue reading the concoctions of this proponent of an insane doctrine of "strategic defense" based on the principle that the best defense is aggression. A necessary step to this end, opines Graham, is for the Pentagon to launch additional satellites capable of blinding or destroying other satellites, as well as to deploy land-based "high-energy cannon" able to knock out missiles before they reach their targets. A comprehensive civil defense system will then be developed, just in case some "enemy rockets manage to break through the antimissile defense system."

A versatile program, no denying that. Especially since it is to be supplemented by an antisatellite system called ASAT each complex of which consists of a modified F-15 fighter and a two-stage Sram-Altair rocket which the plane fires at an altitude of 25 kilometers. The 30-centimeter-long nose cone of the rocket is its space "interceptor" (manufactured by Vought). Homed in by eight miniature infrared sensors, it is accelerated by dozens of tiny rocket engines to a speed of 15 kilometers per second and literally transpierces the satellite, putting it out of action.

In an interview with TIME magazine a Pentagon official, demonstrating his bosses' (and his own) dedication to an imperialist policy of global terrorism now threatening to spill over into



space, proudly boasted that with the ASAT system "we can clear the skies in 24 hours."

In the meanwhile the new weapon has already gone through its first tests which, as Congressman Fortney Clark noted with regret in the NEW YORK TIMES, "signalled the beginning of an arms race in space."

The Pentagon plans to form two squadrons of F-15s equipped with 56 antisatellite systems and deploy them in 1987 at the air force bases of Langley, Virginia and MacCord, Washington, in other words, on the east and west coasts of the U.S.A. Organizationally ASAT will be subordinated to the U.S. Space Command and will be operated by the Space Defense Center in the Cheyenne mountains. Subsequently the number of planes defending American "interests in space" is to be raised to 112 and deployed in areas far beyond the borders of the U.S.: the Falkland (Malvina) islands (wrested by Great Britain from Argentina in 1982 not without American help) and possibly even New Zealand. From here, and American military circles make no secret of the fact, it is easier to sneak up to Soviet space targets which include, among others, the "Salyut" orbital stations and meteorological satellites.

Given all this, the demagogic pronouncements of chief of USAF Space Command lieutenant-general J. Martinger sound more like mockery: in an interview with U.S NEWS AND WORLD REPORT he declared that the U.S.A. "must have an antisatellite system, not to militarize the cosmos, but to be capable of protecting its interests in space and ensuring its right to self-defense".

Another instrument used by the Pentagon with growing frequency to achieve superiority in space is the multiple-use spacecraft of the "Shuttle" class which, in the words of the WASHINGTON TIMES, must become "a powerful weapon in the American arsenal".

That is why at every launch of these spaceships the Defense Department has been given final say on exactly what "luggage" will go aboard.

That is why over one third of all flights planned for the four space shuttles "Columbia", "Challenger", "Discovery" and "Atlantis" through 1994 have already been "booked" by the military.

That is why military crews for future shuttle flights are currently undergoing training at the Johnson Manned Space Center in Houston. Moreover, the UPI reports that the whole system of mission control and data processing at the Center is being completely reorganized to satisfy the requirements of Defense Department programs.

That is why at Vandenberg air force base in Reagan's beloved California a space center is being created to handle military shuttles with special missions.



As a matter of fact, the missions, itineraries and objectives are now being determined by the Pentagon.

"Who said," asks American physicist S.Ramo, "that this hardware will be used solely to bring down missiles in the sky? If it's so good, why not use it to destroy targets on the ground?"

Is that perhaps the purpose of laser weapons tests already being conducted on the shuttle flights in violation of existing treaties?

/16 May 84 p 4/

### The Laser Terrorists

Judging by the facts, in the minds of the American military laser and other ray devices occupy a special, "privileged" position as the most effective "star wars" weapon of all. After all, it has a range of 2000-4000 kilometers and can hit moving targets in a very short time frame.

The idea of transforming laser rays into death rays is not new among the warmongers. It was frankly set forth almost fifteen years ago in his book "The Weapons of World War III" by American journalist J.S.Thompkins, an expert on military affairs: "In an age of rockets, satellites and space travel it is difficult to reject the idea of death rays."

Now we know: the "idea" won the most ardent support of the Pentagon from its very inception. According to USAF atomic laboratory documents published by the KNOXVILLE NEWS-SENTINEL, the military first took an interest in laser weapons systems several decades ago. It became evident that a laser weapon, were one to be created, would possess several attractive characteristics, said a recent report. Inasmuch as the speed of light is 186,000 miles per second (300,000 kilometers), "the killer ray would hit its target almost instantaneously, thus eliminating the need to track targets except for the most distant ones." One can envision, the report continues, the creation of a powerful nuclear arms system that would swing methodically from target to target across the whole azimuth, focus its beam on a specific target, fix the beam on a selected aim point whatever the target's speed and maneuvers, burn a hole in the exterior casing or destroy one of the targets vital components or ignite its fuel or, finally, cause its warhead to explode. Using mobile mirrors and a highly sophisticated system of mirror control, this weapons system would allow the ray to be shifted from one target to another and "successfully carry out scores of strikes".

These "fruitful" ideas were first put to the test in Vietnam. Over a period of several years the GI's bombarded its inhabitants with laser-guided shells, using the long-suffering country as a testing ground for the new weapon.

When Reagan moved into the White House the interests of the military establishment and those of the president came to coincide as never before. As witnessed by former presidential adviser W.Clark, Reagan's deep interest in anything to do with laser weapons in space harks back to the time he was governor of California. Such enthusiasm could hardly be called accidental. It is not for nothing that the present head of the White House is often referred to as a protégé of the military-industrial corporations of the Sun Belt.

It was not just anywhere, but precisely here, in the head offices of corporations specializing in aerospace weaponry, that plans for the militarization of the cosmos were first hatched, plans sometimes pompously referred to as the "new national strategy" of the U.S.A. The vast influence these corporations exert on the country's political course was demonstrated once again by the quick way the implementation began of the "star wars" scenario which boils down to a policy of space terrorism so dear to the hearts of its sponsors.

That is why today such favorable publicity is being given to the experimental destruction by lasers of the smallish supersonic "Sidewinder" rockets carried out by the laser laboratory of the USAF in that same California.

That is why so widely advertised is the research being done by Dr.Lowell Wood, a tough-policy advocate whose ideas jibe perfectly with the plans laid by the bosses of the military-industrial complex (VPK). At a National Press Club seminar Wood, head of a special research group at the Lawrence radiation laboratory in Livermore, stated that the technological background for deploying in the next five-eight years a laser system capable of destroying submarine-launched ballistic missiles exists today. To this end it is proposed that the system in question be equipped with land-based lasers and so-called "jumping" mirrors which would focus a powerful laser emission on the missiles. During periods of heightened tension these mirrors would be launched into space, the physicist stressed. Inasmuch as none of the components of such a laser system would be permanently deployed in space, its creation, in his words, would not be in violation of the 1972 treaty on limiting antimissile defense systems.

So that's what's the matter! Mr.Wood, who thinks that "the non-deployment of antimissile defense systems is fraught with the danger of nuclear catastrophe" (a queer kind of reasoning on the part of this pseudo-peacelover - V.R.), attempts at one stroke to surmount for his brainchild the barriers put up by the current Soviet-American treaty on limiting antimissile defense systems. However, Article 5 of that treaty forbids not only the deployment, but the development of space-based antimissile defenses. Now, then, should Dr.Wood proceed? What if the project is stymied by some pernicky congressmen and the 10 billion dollars necessary to create the system are not allocated? Why, for that kind of money there's nothing

you wouldn't do, even emulate Setaurus, a crazed robot who used a mine-digging laser against people (from a story by the well-known Polish sci-fi author Stanislaw Lem).

Who knows, perhaps Wood will find it easier to take "the beaten path" in persuading the Congress to allocate funds for yet another of his pet projects in antimissile defense - a system of huge satellites placed in geostationary orbits and equipped with chemical and optical lasers. These mastodons will each weigh up to 1000 tons, be stationed 36000 kilometers above the earth's surface, have flawless mirrors up to 40 meters in diameter and a beam of about 100 million watts. This is only ten times less than the capacity of a medium-size atomic power plant.

A million lamps in orbit, not to illuminate, but to incinerate life!

#### EMP Upsets Reckless Plans

Granted, many of the facts listed above today sound fantastic. Granted, to make the transition to these gigantic devices from lasers that bring down "Sidewinder" rockets is, in the words of MIT professor Jack Ruane, "like switching straight from a kite to a Boeing-747". Nevertheless, at the present time the U.S. military-industrial complex has almost nothing to fear from the White House in the way of objections.

The draft of the federal budget for fiscal 1985 has 2.1 billion dollars earmarked for the creation of laser, ray, antisatellite and other "cosmic" weapons. In actual fact, though, the sum will be double that figure, a fact established by specialists from the Federation of American Scientists. These additional expenditures were "buried" by the Reagan administration in the budget of the Federal Emergency Control Agency, in funds designated for maintenance of the testing range on Kwajalein island and in a number of other budget items. All in all, it is bent on funding the intrusion of the arms race into space with 3.9 billion dollars in fiscal 1985 and 7.2 billion in 1986. But, cautions an American scientist in TIME magazine, "when these projects gather some momentum, stopping them will be well-nigh impossible".

Judging by the evidence, the American administration has no intention of stopping. It is eager to transform the "in" fantasies of Hollywood into blood-curdling reality, to transpose "star wars" from the screen to a very real, space-terrestrial theater of operations (the assumption is, naturally, that the latter will be outside U.S. air space).

As reported by the magazine PROGRESSIVE, American specialists have determined that a one-megaton bomb detonated by laser at a height of 450 kilometers over Omaha could, by way of the so-called electromagnetic pulse (EMP) generated thereby, knock out telephone



and radio communications, television, electricity networks and radar systems over the entire territory of the U.S.A. Computers' memories would be erased, their digital systems would start giving the wrong signals. Electronic control systems and meteorological satellites would be rendered useless. Air and ground traffic would be completely snarled: with no radio contact and no radar information to hand, aircraft would search in vain for the safest place to land, and late-model cars, equipped as they are with microprocessors, would come to a halt. The entire economy would, consequently, be paralyzed. Even U.S. Secretary of Defense Caspar Weinberger was forced to admit that "it would be naive to say that we have available ready, economically feasible and technologically implementable solutions" to the EMP problem.

These "revelations" were not prompted by the goodness of his heart. The EMP, it turned out, can affect not only the economy, but politics too. It puts paid to Washington's adventuristic and demagogic plans for a "limited" or "prolonged" nuclear war which cannot be waged unless communications are 100 percent reliable. In an attempt to salvage a doctrine doomed to failure, the head of the American war department puts a good face on a bad situation when he declares that "significant improvements" have been achieved in the matter of solving the EMP problem. Billions of dollars have been allocated for this purpose and billions more will doubtlessly follow, the simple reason being that to avoid the effects of electromagnetic pulses the command, guidance and other systems must replace metal wires with glass fiber, in effect - make a complete transition to "light communication".

But who knows what to undertake if other such "phenomena" arise? The EMP problem is a reminder to mankind of the as yet unknown but devastating consequences of nuclear war in general and war in space in particular. The EMP belongs to an absolutely new category of dangers. Not only are they impossible to accurately predict, they cannot even be tested on scaled-down models, in laboratory conditions or the research and development stage. How many more such dangers exist in nature which have not been discovered yet and which perhaps only some unforeseen catastrophes are capable of identifying?

Evil will once again breed evil.

[18 May 84 p 4]

#### In Pursuit of a "Torrent of Gold"

The new technology has triggered a whirlwind of commercial passions. The arms race in space translates on the ground into a race between the military-industrial corporations for orders which promise the capitalist such huge profits that to achieve them, in the words of G.Dunning (Karl Marx cites him in "Capital"), "there is no crime he would not dare commit, even under risk of the gallows".

Judge for yourself. In the beginning it was estimated that one launch of the multiple-use "Shuttle" craft would cost less than 10 million dollars. In the course of construction the price changed as often as in a kaleidoscope, finally topping the 200 million dollar mark. In all, the military-industrial complex will get about 5 billion dollars from the Pentagon for building four "Shuttles".

As soon as President Reagan announced his space-militarization "initiative" and space "antimissile defense" program, the New York commission of "Cyrus Lawrence" forthwith introduced new company stationery with the logo "Money from heaven". Joke or no joke, but press reports have it that behind the allegedly "fantastic" projects of the head of the White House stood the very real financial interest of corporations that produce the weapons of death: their profits should begin to soar with truly cosmic speed. Orders for the development and creation of laser weaponry had been placed by the war ministry with "Rockwell International", "Lockheed" and "TRW" even prior to the president's speech. The down payment was 2 billion dollars.

The militaristic cosmic spiral coils upward at breakneck speed. As estimated by the Fletcher commission, a "modest system" of antimissile defense will cost about 100 billion dollars in its initial variant. This is roughly equal to what the U.S. spent on all military space programs prior to the current administration, but critics skeptically insist that the actual cost of implementing Reagan's "dream" will be 4-5 times higher. The NEW YORK TIMES cited some figures - the first generation of laser weapons alone will cost taxpayers the astronomical sum of 100 billion dollars. The same paper reported that three main "ray gun" projects have already been approved and the contractors selected. Work has begun in "Lockheed" laboratories on two of them, dubbed "Talon Gold" and "Lodge". "TRW" was assigned the "Alpha" project.

An all-out struggle is in progress for other projects. Among the contestants are "Lockheed" and "TRW" again, as well as "Perkin-Elmer" and "Charles Stark Drenner". Also on the prowl for orders are such companies as "Boeing", "Martin-Marietta", "Itec", "Avio", "Northrop", "United Technologies", "Eastman Kodak", "Ford Aerospace" and "Corning".

Even congressional hawks, reports ROLLING STONE magazine, who are staunch supporters of the "star war" concept, are said to be concerned about the costs involved. One of them admitted: "Instead of choosing the correct plan, we will end up building whatever the lobbyists succeed in pushing through".

Thanks for your outspokenness, even though it adds nothing to what is widely known as it is: the sharks of the military-industrial complex and the Capitol have always come to terms. Stressing the venality of imperialism's lackeys, V.I. Lenin wrote as far back as



1913: "A golden shower is pouring straight into the pockets of bourgeois politicians who comprise a closely-knit international gang inciting peoples to competition in the field of arms."

Over 70 years have elapsed, but judging by the facts, Western politicians have not changed. To illustrate the fact, here are just a few data from a study conducted in the late 70s-early 80s of the ties linking the major American arms producers with government and congress. It came to light that all of them are in one way or another quite broadly represented in various governmental consultative committees where the corporations' people develop the most promising projects. Also revealed was the steep increase in the "coalescence" of the war corporations with the state apparatus thanks to an annual two-way flow of specialists. In the seventies alone there was a mutual exchange of 2000 specialists with eight corporations. Such Pentagon contractors as "McDonnell Douglas", "Lockheed", "Honeywell", "Grumman" which have their own lobbyists in Congress, writes the prominent American scientist, NYU professor P. Robb in *NEWSDAY*, succeed in pushing through increased military spending year after year.

Militarism, in his words, has become the main field of endeavor of the executive branch in the U.S.A.

It is not surprising, therefore, that the current administration, many of whose members are protégés of major corporations, has so enthusiastically embraced the "star wars" idea.

After reaching the saturation point in allocations for all the traditional fields - strategic and "European" nuclear arms, conventional and chemical weapons - Washington gradually discovered a new gold mine. A rich mine to be worked many years, a mine with such brilliant prospects as never before imagined by the big-business bosses of California or Texas with their large concentrations of war industries in general and, as pointed out earlier, of the aerospace industry in particular.

In his request for funds to militarize space C. Weinberger cynically declared: "A reduction in military spending signifies an increase in unemployment", completely forgetting that according to official Bureau of Labor Statistics figures, 1 billion dollars invested in the civilian branches of the economy generate up to 123 thousand jobs, almost three times as much as when the same sum is gobbled up by military industries.

A strange brand of arithmetic for a minister of a country where the current unemployment rate, according to a report drawn up by a group of prominent Democrats, is "higher than at the peak of any other postwar recession, with the sole exception of the recession of 1974-75."

Well, much can be said about the Pentagon chief, but there is no way he can be accused of an inability to count. With but one exception - when the matter concerns funds for the military budget. Convincing the lawmakers (even though they are full of "understanding", but with so many skeptics around) that the military Moloch desperately needs 313.4 billion dollars, a sum 2-2.5 times larger than 3-4 years ago, was no joking matter. (Such exorbitant demands prompted the following comment from former chairman of the Senate Foreign Relations Committee W.Fulbright: "This military budget is so colossal you can't shake the feeling that we are preparing to wage and win a nuclear war.")

It was here in the Senate, in the Armed Services Committee, that the defense minister of the U.S.A. once spelled out his political credo: "We will spend everything (emphasis mine - V.R.) necessary to strengthen our military capability as quickly as possible. As pointed out by President Reagan, we must negotiate with the Russians from a position of strength."

This statement still brings the military-industrial tycoons to a state of indescribable elation. Because put otherwise, what it means is this: the corporations should have no fear of the technical difficulties that might arise in the process of creating "star wars" weaponry even if additional expenses are incurred. They will get all the money they ask for.

After all, the president himself subscribes to the same principle of "What the military-industrial complex needs, America needs". Summoning demagoguery, as he usually does, to be his ally, R.Reagan is trying to convince his fellow-citizens that thanks to the efforts of his administration they are on the road from "the dark days of despair to the shining dawn of promise and hope". But demagoguery was always the helpmate of deceit. Nobody can confirm this better than the 37 million Americans who now find themselves below the official "poverty line", or the 44 million hungry whose "army" is being continuously reinforced because of the unrestricted arms race.

#### New Problems - New Profits

R.Reagan and his closest associates, looking at the world through special glasses of military corporation vintage, assiduously and, it would seem, wilfully disregard the warnings of major scientists and specialists from the most diverse fields of knowledge who are skeptical about the technical implementability of the "star wars" concept and the practical realization of the "strategic defense" doctrine. And they pay absolutely no heed to or direct bitter criticism at all those who point to the political aspect of the problem, who caution against the dangerous escalation of the arms race and the very real threat of a nuclear war. Because, as American physicist and military expert Richard Garvin told the West German

magazine DER SPIEGEL in an interview: "Atomic arms alone, however, will not necessarily lead to war, but the combination of offensive weaponry with the promise of your own 100 percent protection will certainly lead to war."

R. Delauer, who heads scientific research in the Pentagon and who cannot be characterized as an opponent of the new weapons system, admits that before it is created at least eight technical problems will have to be resolved. Each one of these will cost at least as much as the Manhattan project to create the first atom bomb.

"But the new space-war strategy", concludes NYU physics professor and director of the Institute for Peace and Safe Technology M. Cacou, "acquires such a sinister character not because of its huge cost, dubious effectiveness or high vulnerability, but because of the potential escalation of the arms race to a new destabilizing level."

What does it matter if effective countermeasures have not yet been found against the EMP that follows on the explosion of a nuclear bomb and indiscriminately puts power grids out of action? What matter if there is no clarity on how to supply power to cosmic ray guns in orbit, each of which may require the output of several nuclear power stations yet is easily neutralized by low-cost countermeasures or knocked out altogether? What if nobody can tell whether the creation is at all possible of laser guns a million times brighter than is achievable today and with a very high rapid-fire capability and degree of accuracy? Who cares if the fate of all human beings on the planet is entrusted in full measure to computers whose slightest error can well plunge the world into a nuclear apocalypse?

All this hardly bothers the apologists of a "cosmic cudgel". The military machine has started rolling, the product that will emerge has been approved at the very top. And new difficulties will only translate into new dollar injections.

It should be noted that the headlong militarization of American activities in space is being conducted at the expense of the pursuit of civilian objectives there, leaving no room for truly scientific work in this field of endeavor.

In the long run "American space exploration for peaceful purposes will be phased out altogether", MIT professor Wippis bitterly remarks. The state, at least, will play a minimal role in the endeavor, "reassigning" its mission to the corporations. In a ceremony marked with pomp and circumstance, President Reagan recently signed an executive order granting private American companies well-nigh limitless opportunities to use space for commercial purposes. They will do so under supervision, of course. The role of "school marm" has been awarded to the chief "space explorer", the Pentagon, whose representatives will have seats on a special interdepartmental group that is to license private ventures in the near cosmos.

### The Mirage of Supremacy

The military race in space is picking up speed. At the same time Reagan's political ploy - to draw the attention of the American and world communities away from the failure of his arms control strategy - is suffering a complete fiasco. In fact, one cannot help asking - was there a strategy at all? In the three years it has been in power, says G.Scoville, president of the Association of Arms Control Supporters, the Washington administration has not taken a single step toward progress in this area.

Reagan and his clique, unwilling to accept "parity with the Soviet Union in the military sphere," wrote the French paper CROIX, "which all American presidents, from Kennedy to Carter, recognized, and which was the bedrock of peaceful coexistence", have raised their messianic pretensions to cosmic heights. Masking the essence of their actions with demagogic phrases about the "noble goals" of those in the U.S. who stand for the creation of an all-encompassing antimissile defense system, the White House has even gone so far in its rhetorical exercises as to proclaim that one fine day after deployment of the system it would be ready "to share the technology of its creation with the USSR."

Is that so?!

The true content of the speeches delivered by the two-faced Janus from the banks of the Potomac was bared by General Secretary of the CPSU Central Committee comrade K.U.Chernenko: "To veil its policy, the American administration is now trying desperately to pass itself off as a "peacelover". What this is really worth, however, is visible to all".

The cosmic desperados from Washington apparently forget that the USSR will not sit on its hands and resign itself to American hegemony. If need be, it will undertake the necessary steps to protect itself and its allies. That's the way it always was and always will be, and history can bear witness to that.

Washington was always the first to begin a new spiral in the arms race. And had always found itself playing the blackmailer. "The Soviet Union", writes CROIX, "each time closed the technological gap separating it from America in the nuclear field in the course of four-five years." The U.S.A. will not achieve military superiority over the socialist countries this time as well, even if it does plant its new weaponry in space. Nevertheless, such a delicate structure as peace will all this time teeter on the verge of catastrophe. "Let everybody know," stressed comrade K.U.Chernenko at his meeting with voters of the Kuybyshev electoral district in the capital, "that no fanciers of military adventures will ever succeed in catching us unprepared, no potential aggressor can hope to avoid a devastating counterblow."



Aware of what nuclear confrontation entails and who its real instigator is, the sober-minded people of America are consolidating against the "star wars" plans of the current administration. Today people of the most diverse political affiliation and social background are embarking on a unified course of action. A case in point is the recently formed coalition for the peaceful use of space which embraces members of Congress, prominent American politicians and public figures, scientists, as well as such collective members as Physicians in the Struggle for Social Responsibility, the Federation of Supporters of Arms Control, the League of Women Voters and others. The coalition is fighting for the complete termination of antisatellite weapons tests, for a treaty between the USSR and the U.S. to ban those weapons, an end to funds for the Pentagon's efforts to create a space-based antimissile defense system; it advocates observance by the U.S. of the terms laid down by the USSR-U.S.A. treaty on the limitation of antimissile defense systems.

These demands stand in sharp contrast to every declaration by the pseudo-peacelover Reagan who at a recent press conference pretended his administration was ready to negotiate a ban on antisatellite weapons, but that such agreements, you see, are "impossible to verify".

A hackneyed ploy: behind a smokescreen of high-sounding campaign rhetoric to shun concrete action on behalf of universal peace and disarmament and to "miss" a report by the Union of Concerned Scientists which states that adequate verification of compliance with the treaty banning antisatellite weapons systems is possible. Answering questions put to him by PRAVDA, comrade K.U.Chernenko emphasized: "When there is a true desire to agree on arms reduction and disarmament measures, control did not and cannot serve as an obstacle."

And what does Reagan's "team" propose? To satisfy the wishes of the Pentagon and the military-industrial complex, its "partners" in the "iron triangle", it does not stop at perpetrating a monstrous deception on the public. And is so successful at it that, in the words of the West German magazine STERN, "apparently at no time in the recent history of the U.S. have so many well-known and competent Americans (including ex-president Carter, ex-state secretary Vance, ex-defense secretary Macnamara, ex-CIA head Colby) been warning their government against a policy of arms build-up and against the misconception that the U.S. lags dangerously behind the USSR".

#### For a Peaceful Sky

Such an approach to the central problem of our time, the problem of peace, coincides with the position of the Soviet Union. For many years now the USSR has been advocating a constructive dialogue to ban the arms race and to agree on the use of space solely for peaceful purposes.



In 1983 the USSR put before the 38th session of the UN General Assembly a draft treaty banning the use of force in space and from space against the earth. The Soviet Union deems it imperative to erect a reliable barrier to plans for transforming the cosmos into a source of mortal danger to mankind. The Soviet draft treaty proposes a total ban on the use of force in space and from space directed at the earth through utilization for that purpose of space objects in orbit around the earth or placed on heavenly bodies, or devices deployed in space in whatever other form as a strike weapon. Moreover, the treaty would make it incumbent on the signatories to assume a clear-cut and concrete commitment to completely ban the deployment and testing in the cosmos of any space-based weapon. It is proposed to resolve radically and in full measure the question of antisatellite weaponry: envisioned is a complete renunciation of the testing and development of new antisatellite weapons, as well as the liquidation of existing systems already in the possession of various states. It is further proposed to ban the testing and utilization for military, including antisatellite, purposes of any manned spacecraft. Use of the latter must be directed exclusively at resolving scientific, technological and economic problems.

In addition to the above-listed measures of the draft treaty, the Soviet Union, demonstrating its good will, took upon itself the commitment that it would not be the first to put any kind of antisatellite weapon into space. This unilateral moratorium will stay in effect for as long as other states, including the U.S.A., refrain from placing any type of antimissile weapon in space.

The peoples of the planet, and the results of the 38th session of the UN General Assembly witness to it, fully and unequivocally support the balanced and realistic initiatives of the Soviet Union. They are against "star wars", against the introduction of gangster methods into space. 147 to 1 - such was the vote for the resolution "Prevention of an Arms Race in Space". The single (!) dissenting voice was that of the United States. Even those who always follow America's lead, whether harnessed to it through aggressive imperialist blocs or bilateral military agreements, did not back the U.S. on this issue.

A report sent down to the Congress by the head of the White House at about this time which dealt with U.S. policy on antisatellite weaponry, and the accompanying letter of March 31 by the same author amounted to a mockery of world public opinion. Here, like on no other occasion, President Reagan demonstrated the ultimate in casuistic drivel where behind such phrases as "the U.S. is studying a number of alternatives in the area of space-weaponry control, with an eye to possible negotiations with the Soviet Union and other countries", he tried to hide the essential and quite unambiguous meaning of his messages: "Till such time as we decide whether practical solutions to this problem exist, I do not

consider entering into official international talks on the subject a constructive step."

So in Reagan's opinion the problem of barring the militarization of the cosmos, in other words - preventing the spread of the arms race to space, does not merit being the subject of negotiations.

This destructive position of the Washington administration aptly illustrates Reagan's policy of taking social revenge on a world scale. As is well known, he has assigned himself the immediate task of sending communism "to the ash heap of history." It is this philosophy that inspired the stated goal of a Pentagon directive for 1984-1988 in the realm of military policy - "to destroy socialism as a socio-political system."

And here are two more excerpts. The first is from declassified memorandum No.7 drawn up by the National Security Council in March 1948: "Routing the forces of a world communism led by the Soviets is of vital importance for the security of the United States." The other is from a declaration by State Department counsel Colin Gray: "The U.S. must plan the defeat of the Soviet Union, but at a price that will not prejudice the economic upsurge in the country. Washington must formulate the war's goals which will ultimately lead to the establishment of a world order compatible with Western ideals....".

Thus, and thus only! Either the world of socialism renounces its ideology, its principles, its very way of life, or it will have to cross swords. Everywhere! In space too.

About 35 years separate these striking testimonials to the hegemonistic aspirations of the militant anticommunists, but what a coincidence of views! You get the impression that one and the same hand wielded the pen in both cases. The same hand, whose name is American imperialism, developed the notorious doctrine of "strategic defense". Only people with deranged minds are capable of producing a document which forecasts that "combining offensive weapons for strikes against armed forces, civilian defense, anti-missile and anti-aircraft defenses should help limit American losses to about 20 million people (is that all?! - V.R.), which will make the American strategic threat more credible."

In other words, relying on a disarming first nuclear strike, antimissile and antisatellite weapons in conjunction with civilian defense measures, the Reagan "star wars" program figures that its authors will climb onto the "shield" from under the shield and escape retaliation in kind. They labor in vain, these "peacelovers" with imperialist ambitions for whom "the population" is not their fellow citizens, but a faceless entity in the Pentagon's computers, an anonymous grey mass that can be overlooked for the sake of realizing "a cherished dream", for the sake of "the right society", the elite of imperialism. But they shall not survive a thermonuc-

lear conflagration, not even in the "flying White House" aboard a Boeing-747.

What is needed in international relations is a sound and realistic approach based on a fundamental principle of our time - the principle of peaceful coexistence between states irrespective of their ideologies or social systems. Speaking about the concrete norms that should govern relations between nuclear powers, General Secretary of the CPSU Central Committee comrade K.U.Chernenko proposed "not to spread the nuclear arms race to new spheres, including space," and voiced our country's readiness to reach an agreement "to work step by step and from a principle of equal security for reductions in nuclear arms right down to their ultimate liquidation in all their variety".

Today, like never before, the imperative need is for unity among all the sane, peaceloving forces of the modern age in their struggle against nuclear madness, against Washington's "star wars".

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# LAUNCH TABLE

## LIST OF RECENT SOVIET SPACE LAUNCHES

Moscow TASS in English or Russian various dates

[Summary]

Date	Designation	Orbital Parameters			
		Apogee	Perigee	Period	Inclination
1 Jun 84	Cosmos-1568	396 km	209 km	90.2 min	72.8°
6 Jun 84	Cosmos-1569	40,165 km	614 km	11 hrs 50 min	62.8°
8 Jun 84	Cosmos-1570	830 km	792 km	100.9 min	74°
11 Jun 84	Cosmos-1571	398 km	218 km	90.4 min	70°
15 Jun 84	Cosmos-1572	297 km	227 km	89.4 min	82.4°
		(Carries equipment for continued exploration of earth's natural resources; incoming data transmitted to State Research and Production Center "Priroda")			
19 Jun 84	Cosmos-1573	317 km	209 km	89.4 min	72.9°
21 Jun 84	Cosmos-1574	1,021 km	985 km	105 min	83°
		(Carries experimental equipment to improve the system for locating ships and planes in distress)			
22 Jun 84	Cosmos-1575	292 km	231 km	89.4 min	82.3°
		(Carries equipment for continued study of earth resources; incoming data transmitted to State Research and Production Center "Priroda")			
22 Jun 84	Raduga	35,100	--	23 hrs 17 min	1.3°
		(Communications satellite for telephone, telegraph and radio and transmission of TV programs; circular, near-stationary orbit)			
26 Jun 84	Cosmos-1576	376 km	180 km	89.7 min	67.1°



Date	Designation	Orbital Parameters			
		Apogee	Perigee	Period	Inclination
27 Jun 84	Cosmos-1577	1,023 km	974 km	104.9 min	83°
28 Jun 84	Cosmos-1578	1,673 km	296 km	105 min	50.7°
29 Jun 84	Cosmos-1579	281 km	257 km	89.6 min	65°
29 Jun 84	Cosmos-1580	367 km	249 km	90.4 min	62.8°
4 Jul 84	Cosmos-1581	40,165 km	614 km	11 hrs 50 min	62.8°
5 Jul 84	Meteor-2	974 km	954 km	104 min	82.5 °
		(Meteorological satellite; carries equipment for obtaining images of cloud cover in visible and IR ranges in storage and direct transmission modes and equipment to measure radiation in near-earth space)			
19 Jul 84	Cosmos-1582	308 km	227 km	89.5 min	82.4°
		(Carries equipment for continuation of earth resources studies; incoming data transmitted to State Research and Production Center "Priroda")			
24 Jul 84	Cosmos-1583	388 km	209 km	90.1 min	72.9°
27 Jul 84	Cosmos-1584	268 km	193 km	88.8 min	82.4 °
		(For continued exploration of earth's natural resources)			
31 Jul 84	Cosmos-1585	324 km	181 km	89.3 min	64.8°
2 Aug 84	Cosmos-1586	40,165 km	614 km	11 hrs 50 min	62.8°
2 Aug 84	Gorizont	35,785 km	--	23 hrs 55 min	1.5°
		(Communications satellite for further development of TV broadcasting; near-stationary, circular orbit)			
6 Aug 84	Cosmos-1587	394 km	209 km	90.2 min	72.9°
8 Aug 84	Cosmos-1588	457 km	438 km	93.3 min	65°
8 Aug 84	Cosmos-1589	1,523 km	1,500 km	116 min	82.6°
10 Aug 84	Molniya-1	40,772 km	479 km	12 hrs 15 min	62.7°
		(Communications satellite for long-distance telephone and telegraph service and transmission of Central TV to points in the "Orbita" network)			
14 Aug 84	Progress-23	267 km	194 km	88.8 min	51.6°
		(Automatic cargo spacecraft to resupply "Salyut-7")			



**END OF**

**FICHE**

**DATE FILMED**

7 Nov 1984